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MEETING OF THE NORTHWESTERN ELECTRICAL ASSOCIATION.

In other columns of this issue will be found a full report of the Milwaukee meeting of the Northwestern Electrical Association. The meeting fully sustained the standard raised by those of the past in the number and general excellence of the papers presented. The paper by Mr. F. S. Terry, on "Incandescent Lamps," shows a careful study of the lamp question, from both the managers' and consumers' standpoint, and although the author has pointed out little that has not been previously considered, yet, as a résumé, it will be found of particular value and interest. In a paper on "Safety Devices for Electrical Circuits," Prof. Stine pointed out the interesting fact that, under given conditions, a fuse wire has a critical length beyond which it will uniformly fuse with the same current, showing that fuse wires should be rated with due regard to the length of the fuses to be employed. As suggested by Prof. Stine, manufacturers should furnish calibration curves with the various grades of fuse wires which they produce. The practice first adopted in street railway power plants of employing automatic circuit-breakers instead of fuses is rapidly becoming universal in switchboard construction. Prof. Stine favors a still larger employment of the mechanical devices by placing them on motor circuits and also on alternating-current circuits for the protection of transformers, pointing out that in the latter case they offer the additional advantage of acting as choking coils, and therefore as lightning protectors. Several lengthy abstracts of the papers will be found accompanying the report, others being necessarily withheld for a subsequent issue.

INTERIOR CONDUITS.

As previously referred to in these columns, the question of employing plain iron pipes for interior conduits was discussed before the recent meeting of the Underwriters held in New York City, and provisorily acted upon, final decision depending upon the results obtained by the committee appointed to experimentally investigate the advantages and disadvantages of such tubing. The extensive use which various forms of conduits have met with, the uniformly excellent results which they have effected and the enormous and rapidly broadening field open for their application, makes the question of probable future practice one of so much importance that it deserves far greater attention on the part of those directly interested than it has apparently thus far received.

We have noticed with particular interest a variety of iron-armored interior conduits which have recently been developed. Paper, wood, rubber, cement and asphaltic compound inner insulating linings have been placed within steel and iron pipes, the general aim being, apparently, to produce an insulating tube having a minimum amount of metal consistent with the needed strength and rigidity, and one which will permit of bending without cracking or splitting. It must also have an insulating lining impervious to heat and moisture, and at the same time not swell or warp out of its original position when ordinarily exposed to either.

Many who are thoroughly familiar with conduit construction maintain that the insulation should be on the wire, leaving the tube to serve solely as a duct, while others claim that in order to prevent moisture and abrasion the tubes should be lined by some insulating substance; that from a mechanical standpoint abrasion of the wire while pulling in can be overcome by an extra protective covering on the conductor if the tube has a smooth inner surface. It is also

maintained as questionable whether a lead covering adds materially to the mechanical advantages. It therefore remains to determine whether the formation of rust and the presence of moisture can be effectually overcome by simply coating the inner surface of the tube with some moisture-proof paint, asphaltic compound, cement or enamel.

We are informed that the various inspection boards look favorably upon the use of plain piping where single-conductor lead armored wires are drawn through, but will insist upon a lined tube where other methods are employed. There have been, however, several instances where generally approved practice has been departed from and heavily braided twin conductors placed in a single plain steel or iron pipe used.

SOME PROPOSED CHANGES IN THE PATENT LAWS.

We have previously referred to the abuse which exists in the Patent Office owing to the fact that although a United States statute explicitly states that "All applications for patents shall be completed and prepared for examination within two years after the filing of the application, and in default thereof, or upon failure of the applicant to prosecute the same after two years after any action therein, of which notice shall have been given to the applicant, they shall be regarded as abandoned by the parties thereto, unless it be shown to the satisfaction of the Commissioner of Patents that such delay was unavoidable," the Commissioner of Patents has seen fit, and apparently with the best of intentions, to limit the period of prosecution of the claim of an applicant for a patent to six months. Inasmuch as it is now proposed to bring about such a revision of the statute as to make it comply with the present Patent Office regulations, the question becomes one deserving of most careful and earnest consideration.

In his annual report for the year 1894 the Commissioner of Patents points out that the section of the revised statutes above quoted is frequently used for the purpose of sanctioning delays in the prosecution of applications, and that an examination of the oldest applications in the Patent Office "awaiting the action of applicants indicates that an application wanting in merit is thus kept alive because the attorney shrinks from the responsibility of allowing it to become abandoned, and for that reason, just before the two years from the last office action have expired, he amends for the purpose of continuing the application in being." In his report for 1895 he states: "In nearly all of the older applications there was found to be a systematic, repeated, and evidently intentional delay of nearly two years in responding to the action of the Office." It was for this reason that new regulations for the conduct of proceedings in the Patent Office were established and put into effect April 15, 1895. These rules, although contrary to the spirit and the direct letter of the United States statute, have been in effect since that date. Two of them read as follows: "An applicant will be considered to persist in his claim for a patent without altering his specification in case he fail to act in prosecution of the same for six months after the office action thereon, and thereupon the examiner will make a re-examination of the case." "In appealable cases in which no limit of appeal is fixed, no appeal will be entertained by any tribunal in the office unless taken within six months from the action which puts the case in condition for appeal, unless it be shown to the satisfaction of the Commissioner that such delay was unavoidable." In regard to them the Commissioner, in his report to Congress of Jan. 31, 1896, says: "The new rules have been applied by the office with great conservatism and with an anxious regard for the interests as well as the rights of inventors, and it may be said at this time that there is general acquiescence in their validity on the part of the ablest and most thoughtful attorneys. Nevertheless, it cannot be denied that they are open to attack in the courts, upon the question of their validity, and regarded as a matter of policy they are also liable to repeal."

We are informed on good authority, that in certain cases, the Patent Office itself has interposed obstacles to the issue of patents, which have resulted in delays nearly equal to the longest cited by the Commissioner as an abuse by applicants of the privileges of the law. Such cases are represented, with apparent reason, as an exercise of power balancing, perhaps to a limited extent, the abuses upon which the Commissioner so severely animadverts.

As to the power of the Commissioner to inaugurate rules such as we are considering, it may be stated that the Commissioner of Patents, though under the law making an annual report to Congress directly, is a bureau, and not a department officer, his office being a bureau of the Department of the Interior. As a *judicial* officer, his decisions are not subject to appeal to, and revision by, the Secretary of the Interior, though formerly this was supposed to be the case. But as a bureau officer, he is subject to the authority of the Secretary of the Interior. Section 483 of the Revised Statutes of the United States, reads as follows: "The Commissioner of Patents, subject to the approval of the Secretary of the Interior, may from time to time establish regulations *not inconsistent with law*, for the conduct of proceedings in the Patent Office." The admission by the Commissioner in his last report to Congress, of the doubt as to the validity of the new rules and of their being liable to repeal, as above cited, is sufficient comment as to the bearing upon them of that part of the law which we have above italicized.

The practical results attained by the new regulations promulgated by the Commissioner of Patents may be considered as favorable, both to the Patent Office and to attorneys, and it is possible that this amendment may be submitted to by the latter, not, however, as the Commissioner suggests in his last report, under "a general acquiescence in their validity," but on account of its contributing to a settlement of cases between themselves and their clients more expeditiously than under the old practice, by which applications dragged along to an interminable length. But inasmuch as the Patent Office exists primarily for the benefit of inventors and not for attorneys, it follows that it is the interests of the former that are first to be considered. Although the changes which it has been proposed to make legal would, to some extent, aid the inventor by enabling him to obtain a patent with more promptness than under the old system, yet changes which limit his freedom can in no way materially benefit the poor inventor, and may not effectually prevent the delays which rich corporations under other provisions of the rules have in their power to bring about. It would, therefore, in our opinion, be far better to leave the present statutes as they stand and attempt to effect a remedy either by legally fixing a limit during which applications shall pend in the office, overstepping which the life of the patent would be correspondingly shortened, or perhaps, better still, follow out the British system, as previously proposed in these columns, and make the life of a patent begin with the date of filing the application.

Underground Electric Railways for London.

There is quite a boom in London just now in underground electric railways. It certainly cannot be said that the financial experience of the City & South London Electric Line has led the many promoters of these new schemes to introduce their projects. About 1 per cent. after six or eight years is not a very grand return for ordinary stockholders. However, whatever the reason, there are at the present moment about six or seven new schemes of this kind on paper and Parliament is being asked for powers allowing these deep level lines to go in all directions.

The Waterloo & City Electric Line, which runs beneath the Thames River from Waterloo Station to the Mansion House, is making satisfactory progress, but will not be opened for some time to come.

Such is the state of the money market at present in London that almost every industrial concern applying for capital gets it, and there is not much doubt that these underground schemes will be well received when brought forward.

Meeting of the American Institute of Electrical Engineers.

The eleventh meeting of the American Institute of Electrical Edgineers was held at 12 West Thirty-first Street, New York City, on the evening of Wednesday, Jan. 20. The entire evening was devoted to a discussion of electrically driven vehicles. Mr. A. L. Riker opened the discussion and was followed by the President Dr. Louis Duncan, Mr. Reckenzaun, Mr. Coho, Mr. Corson, Mr. Joseph Sachs, Mr. R. W. Pope, Mr. H. Van Hovenberg and Mr. Charles E. Duryea

Mr. Riker stated that the electric vehicle possessed a number of ideal features, being free from heat, odor, noise, vibration and exceedingly simple to control. He stated that the defect appeared to exist in the battery necessary to supply current to the storage battery. The storage battery as at present commercially exploited did not appear to be adapted to this class of service. What is required to meet motor carriage conditions is a battery capable of very heavy discharges, but still not of excessive weight, and this requires some special type of battery. Mr. Riker stated that he had found the best results obtainable from the batteries to be ordinarily obtained on the market, about five and one half watt-hours per pound of battery and capable of furnishing energy for a four to five hour run at the rate of 10 miles an hour with a single charge. Single motors appeared to be best for the purpose of propelling such vehicles, being more slightly efficient, less weighty and cheaper than a double motor arrangement. Bicycle construction wherever possible has certain advantages. However, summing up the various features possessed by the electrically propelled motor vehicle, Mr. Riker stated that such vehicles did not appear to be suited for long-distance travelling, but would be principally successful as pleasure vehicles, where the short, lasting qualities would not be objectionable and where their many advantages would place them in a very superior position.

Dr. Duncan, the president, followed Mr. Riker and also stated that the success of the electric vehicle depended upon the storage battery, and particularly upon the production of a battery of fairly reasonable weight which could be used for the purpose and would be capable of standing a run of about 35 miles with a single charge without extraordinary depreciation. Some batteries give better results than Mr. Riker had stated, but such batteries are not to be commercially had on the market. Dr. Duncan believed that if the electric vehicle is to be entirely successful, some battery must be produced and used which will give the aforesaid traveling capacity. A member asked Mr. Riker what type of battery was used in the Riker electric motor vehicle which contested in the Rhode Island State Fair. Mr. Riker answered by stating that the Q M type chloride accumulator cell was used. Mr. Reckenzaun stated that he believed 5½ watt-hours per pound would be a fair estimate of what commercial storage batteries will do. He stated that it is not only a question of having more capacity per pound of weight but also the ability to discharge the battery at higher rates. He stated that the electric vehicle would undoubtedly be successful as a short-trip motor carriage, but did not think it worth while to experiment with this type of vehicle with the idea of eventually producing a long-trip motor carriage or wagon. The results in Europe appeared to be rather against storage battery electric-motor vehicles and the gas and oil motor vehicles appear to have given the best results. A representative of the Electric Carriage & Wagon Company stated that Messrs. Morris & Salom had been working in the direction of electrically propelled vehicles for some years, resulting in the production of some very successful electrical carriages. He also stated that the Electric Carriage & Wagon Company, which was developing this particular type of carriage, would shortly operate 12 of the improved Morris & Salom vehicles in New York City, making regular trips between certain points, but stated that the route had not been fixed. These trips will probably be from 10 to 15 miles with a single charge of battery. He stated that one of the Morris & Salom vehicles had traveled over 1000 miles with absolutely no accident of any kind as yet. The most recent vehicles developed by the concern he represented would run about 25 miles on one charge of battery, weighed about 2500 pounds complete and about 20 to 30 amperes were used on the battery, which ran the carriage at from 9 to 11 miles an hour according to the grade. The battery weighs from 800 to 900 pounds.

Dr. Duncan followed by saying that there appeared to be a popular notion that a motor vehicle could not be turned over to any novice to operate, but that a special attendant or engineer would be needed. A large manufacturer in this line recently stated to him that he believed electric vehicles to be the only type for use in large cities. Dr. Duncan believed that a most important point to be observed was to prevent the entire discharging of the batteries; if the battery was only half charged or discharged, the best results would be obtained. He requested information upon whether a battery capable of giving a run of 35 miles had been produced and stated that such a battery would certainly at once make the electrical vehicle successful.

Mr. Coho gave some of his experience with storage battery cars and stated that the initial charge of the battery was a very unreliable factor to base results upon in considering the traveling capacity of the car. He stated that when traction was good a 25-mile run could be made, but with poor traction probably only 10 miles could be attained.

Mr. Sachs stated that the storage battery and motor did not constitute the entire problem; there were a great many other features to be considered in the construction of a successful motor vehicle, whether electric, gas or steam propelled, and that a discussion of these other features might be of interest. Mr. Riker stated in answer thereto that there certainly was more in the electric carriage than the storage battery, but he thinks that the rest of the carriage would prove entirely successful or could be made so if a satisfactory battery were forthcoming. Regarding some of the necessary elements to be included in the construction of a motor vehicle, Mr. Riker stated that he believed a low vehicle best, that the conditions to be met with were entirely different from those previously to be considered in any pushed or pulled vehicle. A motor vehicle had to produce its own tractive energy from a self-contained engine, which brought into consideration entirely new elements. Low wheels also appeared to be essential, those used in the most improved Riker carriage being 32 inches rear and 26-inch front wheels. The object seemed altogether to be to produce a light vehicle capable of running about 40 miles on a single charge. The Riker vehicles that have been built have a seating capacity for two passengers and weigh about 1400 pounds. Pneumatic tires have been adopted, as they appear to be best suited for this purpose.

In regard to the electric motor equipment, Mr. Riker stated that he had found the single motor driving both wheels better than two motors, one separately attached to each driving wheel. He stated that the question of gears with the electric motor was exceedingly simple. In a new vehicle now building a slow speed gear has been adopted which is similar to the back gear on ordinary lathes. This was thrown into action whenever it was necessary to climb many heavy grades and pass over bad roads, enabling the motor to work at its best and most efficient point without overexertion.

A particularly important point is the entire automatic operation of the electrical appliances with which the vehicle is fitted. Neglect or a tired feeling suddenly overcoming the driver should be guarded against. He had provided the new vehicles with a safety device, protecting the batteries and motor against overload. Another device which has recently been devised indicates the charge contained in the battery on a dial on the dashboard, so that when the driver notices that the battery is nearly discharged, he takes the proper course to replenish the same and thereby prevents any damage to the battery by over-discharge. This device also takes care of the charging of the battery and automatically indicates when the battery has been sufficiently charged.

The steering gear for motor vehicles is an important item. Short axles upon which the steering wheels revolve pivoted to an axle-tree close to the hub appear to be most successful for this purpose, and were adopted in the Riker construction. With this device Mr. Riker stated that one wheel of the carriage would go over almost any ordinary obstruction without deflecting in any way the course of the vehicle. Mr. Coho asked Mr. Riker whether he had made any tests regarding the current necessary to travel over asphalt or other roads. Mr. Riker answered by saying that the power on asphalt or Belgian pavement appeared to be about the same, and in both cases somewhat less than that necessary on macadamized roads. Regarding the construction of the wheels, Mr. Riker stated that tangent spoke metallic wheel construction appears to be the best for this purpose. In fact, he thinks that metallic wheels are absolutely essential. The motor carriage is a machine, and wood should be avoided in its construction as far as possible.

Mr. Joseph Sachs stated that he recently had occasion to thoroughly investigate the development of motor-propelled vehicles and that his investigation had brought to his notice a variety of conditions that ought to be met in the construction of such vehicles. Among these conditions were the design of body, motor, gearing, steering, con

trolling machinery, disposition of machinery, general operation, care and attendance, cost of operation, facility of renewing the power-generating material or generator, the obstructing and interfering qualities of a motor vehicle upon public highways, comfort and freedom from objectionable features to occupants, speed and grade-climbing ability, appearance of completed vehicles, weight of completed vehicle, and in fact all other elements entering into the construction of a carriage propelled by a self-contained power instead of being pushed or pulled by some exterior power. Above all, safety, ease and absolute certainty of management and control and positive operation of all mechanism are essential. He thoroughly coincided with Mr. Riker in saying that a motor vehicle could not follow the horse-drawn carriage or wagon in design ; the general conditions to be met were radically different. Having chosen the vehicle body, the construction of the frame supporting the body is of importance and the tendency seems to be to adopt the tubular steel frame construction. The placing of the mechanism is of great importance and top-heaviness must be particularly avoided. The safe and successful motor vehicle must have a low centre of gravity not only to prevent upsetting in steering, but also when rapidly traveling over ordinary roads. The power capacity and speed is a feature of importance, as it does not appear to be advisable to equip a vehicle with an extraordinarily large motor, enabling it to climb steep grades at maximum speed or travel along ordinary roads at speeds which would be only possible at odd intervals. The power-capacity of the motor should certainly always be sufficient, but it appears to be more advisable to produce particularly strong efforts by means of low gearing than by calling upon the motor for such. Many of the vehicles that have been devised appear to have been constructed with but very little regard to the proper placing of the weight. In many cases the sufficient weighting of the driving wheels had been entirely neglected and the entire mechanism placed on the steering wheels. Investigation has shown that Mr. Riker's views regarding wheel construction appear the most generally adopted, and while wooden wheels are used in some instances, metallic construction seems to be meeting with more general approval. The tendency to twist the spokes of the wheel is met by the application of power as near as possible to the rim of the wheel. Some inventors have even applied the power directly to the rim.

Steel and rubber tires have been used, but the pneumatic tire seems to have shown itself superior to all others. The peculiar advantage of this class of tire is its flexibility and give when traveling over rough roads where a continuous series of minor obstructions are met with. With the ordinary hard tire the whole weight of the vehicle must be lifted over each little obstruction, but where there is some give in the tire power is saved, because only part of the raising is necessary, which therefore results in a saving of power.

A great variety of steering appliances have been devised, and are particularly important when high speeds are considered. Fifth-wheel constructions seem to be out of the question, and the most approved method appears to be either a device like a fork construction, or the use of short wheel-bearing axles pivoted close to the hub, as mentioned and used by Mr. Riker. The main object to be attained in any steering device is to make the distance between the pivotal point of the steering wheel or axle and the point of contact on the wheel-base as short as possible. It is for this reason that the short-hub pivoted axles have superior advantages, and in some cases such devices are arranged with the pivotal line striking the wheel base contact, so that there is practically no leverage when striking an obstruction. Such an arrangement necessitates the minimum energy to counteract the forces exerted by the obstruction on the wheel tire.

Mr. Sachs said that there were various elements to be considered in the production of the motor, but as the electric motor was to be particularly considered, it could simply be said that this form of motive power certainly embodied all elements tending toward success; in fact, that the motor itself might be considered as ideal. The gearing of such a motor is also an exceedingly simple matter. In some recent productions which had come to his notice the motor was direct-connected without any intermediate gearing to the driving wheels. With, however, the other forms of propelling motors for vehicle propulsion, particularly those running at an approximately fixed speed and in one direction, various devices for producing speed changes and reversals are necessary. Among the various types of speed-changing and reversing gears the following were mentioned : Differently speeded gears which were shifted into different combinations and controlled by a single power clutch ; differently speeded gears, each controlled by a separate clutch ; differently speeded belts on separate pulleys operated either by clutches or belt tighteners ; cone pulley devices ; single loose belt and idler, so arranged that more or less slipping of the belt is produced by the varying pressure of the idler to give varying speed; a variety of frictional disc and roller devices, and also several forms of hydraulic and pneumatic gears. Front and rear driving wheels have been used.

He thought steam or gasoline vehicles extremely complicated, although the excellent showing of the French gas vehicles during the recent races certainly appeared to be a great argument in their favor. He thought the electric vehicles ideal and stated that a method of propelling cabs or coaches along fixed roads between certain points by means of an overhead trolley arrangement appears not to have been thought of. He stated that an arrangement of this kind was at present under consideration and in fact being installed. A single set of outgoing and return wires appeared to be necessary, and the system should be arranged so that vehicles going in opposite directions could pass one another.

Mr. Duryea, a guest, was introduced, as being thoroughly expert in the construction of gas vehicles. Mr. Duryea stated that regarding the truck system of supporting the motor, such an arrangement had a number of disadvantages, principal among which was the opportunity for vibration affecting the motor. He did not consider the odors emanating from the gasoline engine as objectionable as those due to the present method of transportation by road vehicles. Regarding automatic machinery, he stated that he had found a number of so-called automatic engines which would continuously give out when they were most wanted and required more attention than a manually controlled device. Regarding the use of wooden wheels in the Duryea vehicles, he stated that this construction was adopted to prevent as much criticism as possible in the use of extreme departures, and he considered they stood as much abuse as metal when properly placed in the wheel. The side strain on the spoke is found to be greater than the twisting action due to the application of power, and he thinks that the wooden spokes best meet this condition. Recharging of the storage battery as necessary in the present electrically propelled vehicle, Mr. Duryea thought to be a particularly objectionable feature, as he also considered that the vehicle carrying hundreds of pounds of new load for power purposes was vastly inferior to that carrying only a few pounds which could be procured at all times and places. Some vehicles he stated, required usually twice as much fuel as would be needed in a gas-propelled vehicle to do the same duty, aside from the large amount of constantly evaporated water that would be necessary. Concluding, Mr. Duryea said that light weight appears to be the greatest desideratum, and past failure seems to be particularly due to the extremely clumsy and heavy construction.

Mr. Riker answered Mr. Duryea by saying that electric street car practice had shown that at least in the matter of electric motors the placing of the motor directly upon the truck gave the best results. He thinks that when vibration affects the motive power there must be something defective in the construction of the motor. Regarding automatic motors for motor-vehicle purposes Mr. Riker stated that he knew of no more automatic engine than the simple naphtha engine used in small launches, but did not, as yet, hear of its application to electrical propulsion.

Mr. Riker believes that the price at which motor vehicles can be sold is an extremely important feature, the electric construction being apparently the cheapest to-day. A private vehicle will undoubtedly not need any greater traveling capacity than 20 to 25 miles per day.

Mr. Duryea stated that the speed was a much more important factor than ordinarily considered; the bicycle won success simply because it enabled one to travel more rapidly than ordinarily possible by other methods. He stated that men will buy fast horses and costly bicycles not only for pleasure but also to get from place to place more rapidly. He claims that the motor vehicle is not only intended for high speed, but for continued high speed. He thinks that 25 miles traveling capacity would hardly give results superior to those at present attained with the horse. With vehicles of his own construction 50 miles or more can be attained with a single charge of ordinary stove gasoline, which can be procured anywhere, and in case of absolute necessity kerosene can be used.

Mr. Pope stated that undoubtedly a high-speed vehicle would give better satisfaction, but he did not think that the question of long-traveling ability was so very important, as it was hoped some day to have the electric current so universally used that it would be possible to recharge or change batteries whenever required without any serious delay.

The Brooklyn Bridge New Electric Power Plant.

WHEN the railway on the Brooklyn Bridge was opened for traffic in 1883, thirteen years ago, there were very few persons far-sighted enough to predict that the improvements thus afforded for quick and reliable transit between New York and Brooklyn would soon become inadequate. The increased facilities, however, turned an increasing tide of travel to Brooklyn, far exceeding in proportions what any one had ever dared to anticipate, with the result that in a few years it became painfully evident that something must be done to extend the carrying capacity of the railway. On account of the existing physical limitations, the problem presented a front that seemed to be invulnerable, and the skill of the bridge engineers was severely taxed in their endeavors to find a solution of the difficult problem.

About the time the necessity of increasing the transportation facilities became manifest, electric power had attained such a degree of perfection in railway practice that the attention of the engineers was turned in this direction for the much desired relief. It was finally decided that by enlarging the stations at New York and Brooklyn, thus doubling their capacity to handle trains, and introducing electric power for the purpose of switching trains from the incoming tracks to the outgoing tracks, the desired results would be obtained, and with this end in view the work of improvement was commenced two years ago. The work of enlarging the stations, it should be stated to the credit of the bridge officials, was carried on without any serious interruption to the enormous traffic passing over the bridge twice daily.

The plans for the improvement of traffic facilities provided for an additional electric power plant and the switching of trains at the termini by electric motor cars. During the past few months THE ELECTRICAL WORLD has published various items concerning progress in the new work, and as the new power plant and the entire electric system is about to be put into active service, the description of the same which follows will be both timely and interesting.

It should be stated, by the way, that the improvements in the bridge railway system contemplate the use of four tracks, two on each side. The rails, however, are not laid the usual distance apart, on account of the limited lateral space available. The two additional rails which have been recently put down on both sides of the bridge are set within a few inches of the old rails, and to all appearances trains passing over one or the other will occupy practically the same position on the structure.

The object of this latter improvement is to increase the headway of trains, and in carrying it out two cables will be kept in operation, thus dividing the work between the two. The two cables and the two sets of tracks will be used by the trains in alternation. The rails of the second track have already been laid, and workmen are now engaged in laying the second power cable.

These improvements, it is calculated, will largely increase the carrying capacity of the railway, and will enable the loading and unloading of two trains at both stations at practically the same time.

It is stated that under the new arrangement it will be possible to keep 18 trains in motion during the rush hours. Practically, the improved plans provide duplicate lines in both directions, so that it will hardly be possible in the ordinary course of things for the bridge system to be completely suspended, because in the case of the failure of one cable or its machinery the duplicate will be available.

In the following description of the new electric system each integral part is described in the natural order of its relation with the system as a whole, beginning first with the source of the power, the boilers; then through the chain of connecting links, the engines, generators, switchboard, etc.; to the practical operation of the cars.

THE BOILER PLANT.

The additional steam boilers necessary for the operation of the new power plant has been provided for by the installation of two Babcock & Wilcox water-tube boilers of 420-hp capacity—210 horse-power each. The two boilers are arranged in one battery and have a total heating surface of 4836 square feet, and a total grate surface of 102½ square feet. The heating surface of each boiler consists of two steam and two water drums 36 inches in diameter and 23 feet 4 inches long, placed above and connected to a set of 12 sections of tubes, each section consisting of nine tubes 4 inches in diameter and 18 feet long. The lower ends of the sections are connected to a mud drum. The cylindrical portion of the

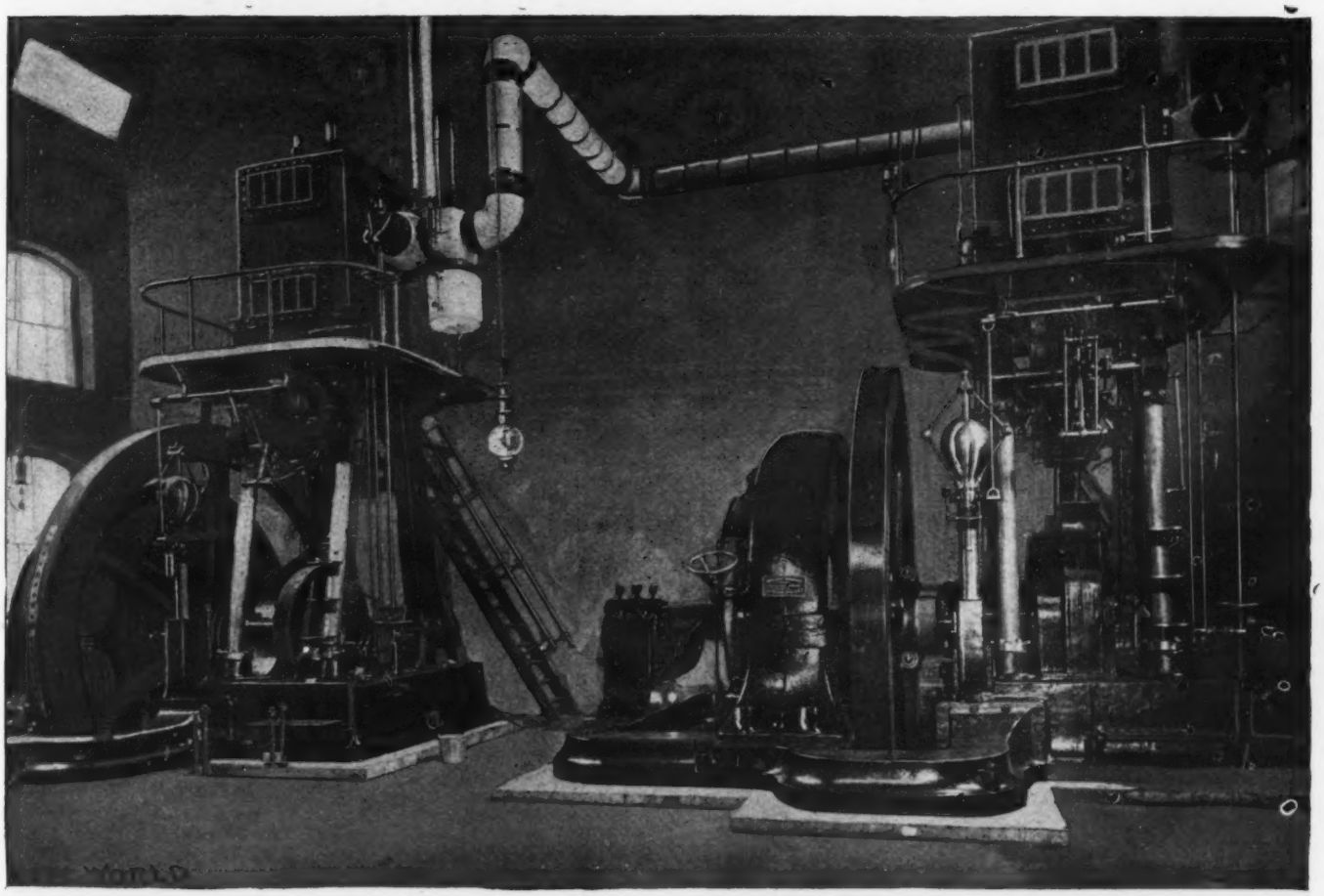


FIG. 1.—GENERATING SETS.

drum is made of three sheets, each $\frac{7}{16}$ of an inch, in thickness, the longitudinal seams being butt strapped inside and out.

These boilers are of the Babcock & Wilcox ordinary standard design, except that the headers are made of forged steel instead of

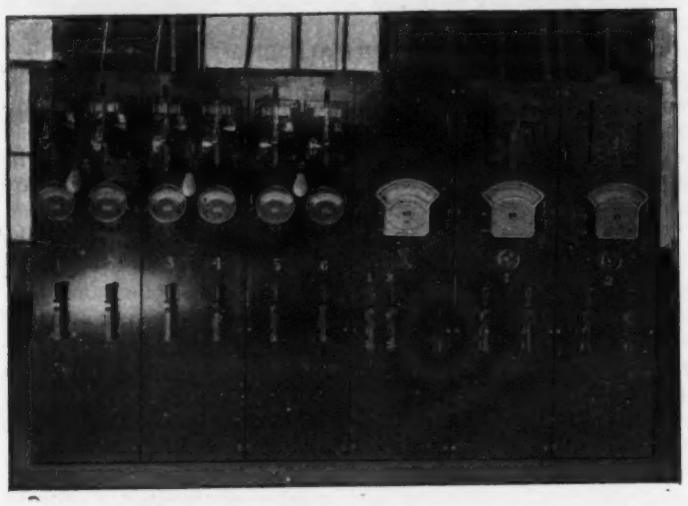


FIG. 2.—FRONT OF SWITCHBOARD.

cast iron, for the purpose of withstanding the high pressure. The cross boxes are also made of steel instead of cast iron.

The boilers are designed to carry a pressure of 200 pounds per square inch, and each is provided with two Consolidated Company's nickel-seated safety valves, 4 inches in diameter. The space occupied by the battery, including brickwork, is 23 feet 5 inches long, 19 feet 6 inches wide, and 15 feet 6 inches high to the top of the steam flange

THE ENGINE PLANT.

Two vertical, non-condensing, high-pressure engines, made by

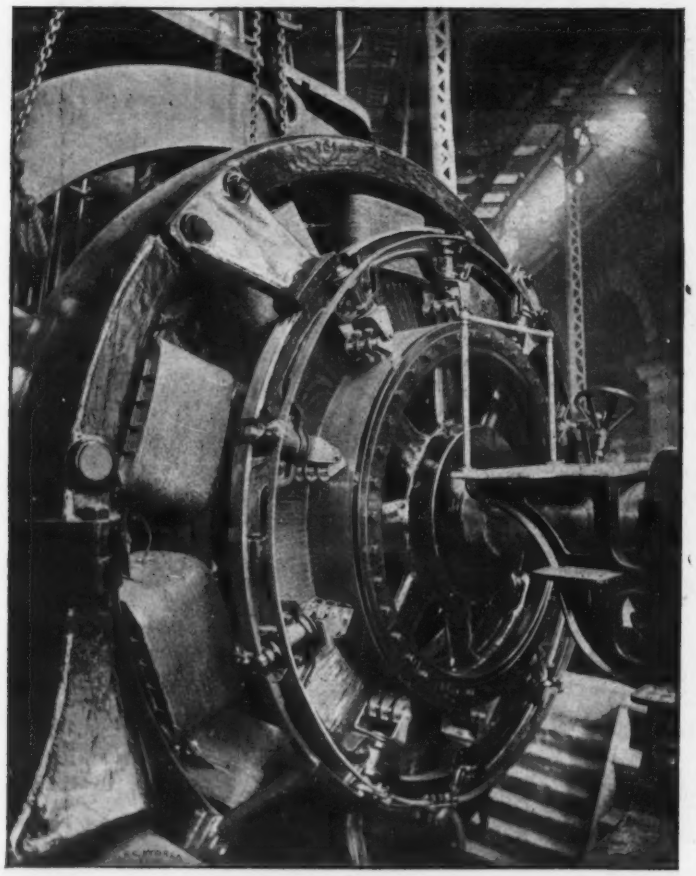


FIG. 3.—ONE OF THE GENERATORS.

the Southwark Foundry & Machine Company, Philadelphia, Pa., supply the driving power for the two generators. These engines, which are direct-connected each to a Walker 400-kw railway generator, are of 600 horse-power each, running at 100 revolutions per minute, with cylinders of 36-inch stroke and 30½ inches in diameter.

The steam cylinders have four independent flat balanced valves, two for admission and two for exhaust, the same as is used in the company's standard Porter Allen engines. Each valve is balanced by the equal distribution of the steam pressure around the same. A Porter governor controls the admission valves automatically through the medium of the company's patented radial valve gear, the motion for which is taken from the connecting rod, instead of the usual eccentric, which is conspicuous in this engine by its absence. The governor runs at about 450 revolutions per minute, being operated by a belt connection with the main shaft through gearing which increases the speed at the ratio of 2 to 1. The speed of the governor can be regulated by merely changing the position of the counter-balance on the governor lever.

The regulation of the engine is effected by means of the action of the governor, which controls the cut-off by moving the link-block in the stationary link. This mechanism is clearly shown in one of the illustrations. When the governor is at its greatest extremity no steam is admitted to the cylinder at any part of the stroke.

FIG. 4.—BACK OF SWITCHBOARD.

The exhaust-valves are controlled by a strap connected with the link, and can be adjusted without removing the covers from the steam-chest.

The starting-valve is of the balanced type with two seats, the steam being admitted between the seats. It can be opened and closed from below, on the floor, as well as on the cylinder platform.

The valve-rod is extended from the valve down to the engine-bed, where it terminates in a hand-wheel, and is connected to a locomotive reversing-lever in such a manner that when the latter is moved backward or forward it pulls the rod down, thereby closing the admission-valve. In its normal position the reversing-lever stands perpendicular, and only in case of a sudden emergency is it permissible to use it. Its only office is to suddenly cut off the steam. The ordinary hand-valve is used in the regular way in every-day practice.

The drips from the cylinder and steam chest may be operated from below by means of a set of levers, and any condensed steam in either

the cylinder or steam chest can in this way be quickly allowed to escape. This arrangement avoids the necessity of the engineer going above to clear the cylinder and steam chest.

In order to prevent the escape of heat from the cylinders by radiation, they are overlaid with magnesia covering to a depth of three inches and over this is placed the lagging.

The height of the engines from the floor is 15 feet 8 inches. The main bearing boxes are independent and can be taken out at any time and renewed with facility.

The engine bed, together with that of the generator, is one casting, with general dimensions of 22 feet 6 inches by 18 feet. The bed is secured to the foundation by means of 20 heavy bolts running through the masonry work 10 feet.

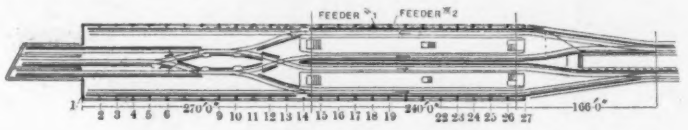


FIG. 5.—THIRD-RAIL SYSTEM.

Each engine is provided with a heavy balance wheel made in halves, the same being fitted together with bolts and shrunk links.

THE ELECTRIC GENERATING PLANT.

Current will be generated by two 400-kw Walker generators of the multipolar type, direct-connected to the two vertical, high-pressure, non-condensing engines above described. These generators are of the Walker Company's standard type, which is already familiar to the electrical trade, and are rated at 500 volts and 800 amperes at a speed of 100 revolutions per minute. They are over-compounded 10 per cent. for 550 volts. The magnet yoke is of cast iron, which, on account of the greater section required as compared with steel, a much greater rigidity is obtained. The poles, of which there are 10, are of soft iron, laminated and cast into the yoke. They have pole shoes of cast iron, which serve also to keep the magnet spools in position. The yoke ring rests upon broad feet at each side, which are securely bolted to the heavy cast-iron bed, which is made in one casting to support engine and generator. The size of this bed-casting is 18 feet wide by 22 feet 6 inches long. The bed rests upon a massive masonry foundation. By removing the bolts which secure the yoke to the bed-casting, the yoke may be slid along in a direction parallel to the shaft sufficiently to be entirely clear of the armature, thus allowing complete accessibility to both magnet coils and armature.

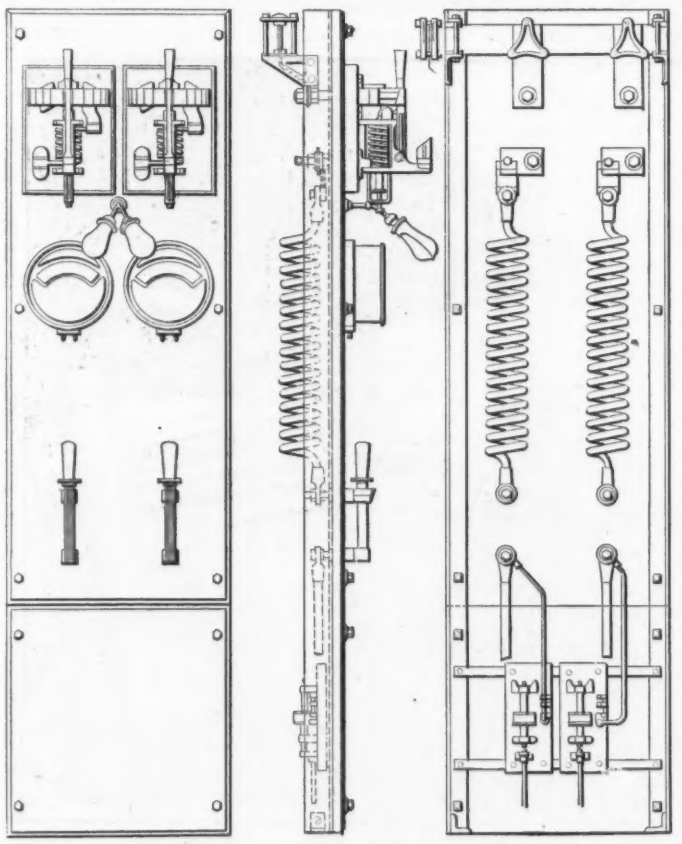


FIG. 6.—FEEDER PANEL; FRONT, SIDE AND BACK VIEWS.

The engine and generator bed-plate is secured to the capstone by means of twenty 1¾-inch bolts running through the foundation for 10 feet. A pocket is provided in the foundation around each bolt at the lower end to afford accessibility for examination, etc. The outside diameter of the yoke is 12 feet 2¾ inches, and about one third of its circumference is below the level of the bed and floor.

The armatures of these machines are of the ironclad type. The plates are punched in segments from soft, well-annealed iron, and secured by dove-tailed projections fitting into corresponding slots milled in the rim of the spider. They are held longitudinally by heavy end rings, the fastening bolts passing just inside of the laminated core. These end rings also serve as supports for the portion of the armature winding outside of the slots. The rim of the spider is not made solid, the arms ending in a sort of T-head. This form of construction is designed for the purpose of eliminating all danger of shrinkage strains and is a very simple and effective method of accomplishing this result. In addition to several other advantages of this design it gives a better chance for more thorough ventilation of the armature core. The commutator spider is mounted upon a projection of the armature hub and securely keyed thereto. The laminated core is divided into a number of sections separated by one half inch air spaces, thus allowing an ample circulation of air.

The armature winding consists of flat copper ribbon formed into proper shape previous to assembling and is entirely without joints except at the commutator leads. The coils are very thoroughly insulated and are held in place by phosphor-bronze bands.

The commutator bars are held in place by a sectional clamp so designed as to draw the bars firmly down onto the flat cylindrical surface of the spider.

The brush holders clamp the carbon brushes solidly, thus giving the current a path of low resistance from brush to stud with no sliding contacts. The brush has a parallel movement so that there is no rocking motion of the carbon in case the commutator is slightly out of true. The brushes are regulated by the usual hand wheel.

The shaft of the generator is of forged steel, and between the generator and the engine is the large engine fly-wheel having a diameter of 16 feet.

The cast iron bed is insulated from the masonry work by a layer of sulphur, three barrels of this material being used for each unit. In order to run the sulphur and keep it within its proper limits, a dam had to be constructed all around the bed to prevent the molten sulphur from escaping where it was not needed.

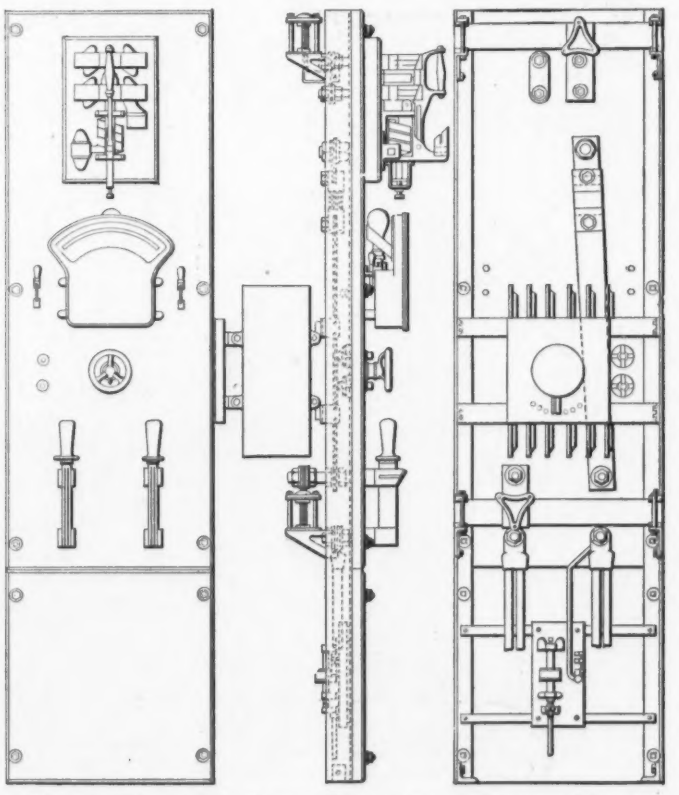


FIG. 7.—GENERATOR PANEL; FRONT, SIDE AND BACK VIEWS.

THE SWITCHBOARD.

This essential feature of the generating plant is constructed on the

Walker Company's standard panel system, and as this is a recent development of the Walker Company's business, a description of the board will be of particular interest.

The board is constructed of black marbleized slate, and is divided into six panels, two of which are for the machines, one instrument panel and three feeder panels. They are all of the same height. The board is so designed that it may be extended at any time without sacrificing any of the existing convenient features or its symmetry. In dimensions it is 12 feet long by 7½ high.

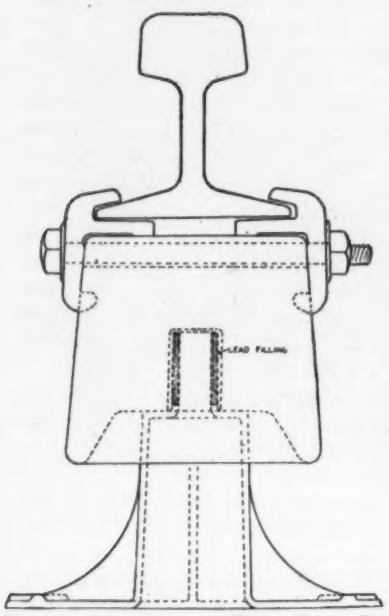


Fig. 8.—Diagram of Third-Rail Insulator.

Fig. 9.—Third-Rail Insulator.

Fig. 10.—Emergency Valve Release.

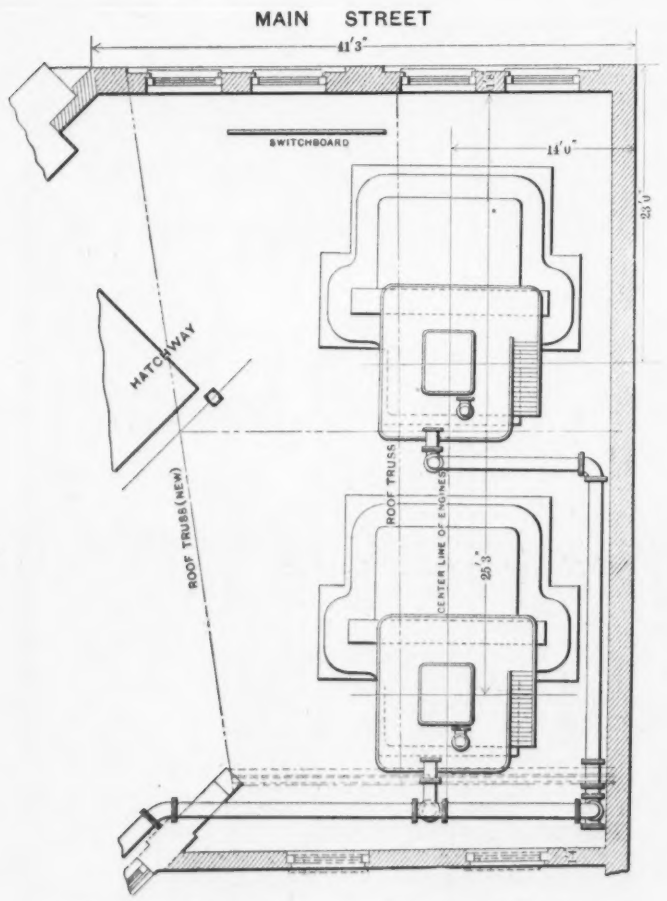


Fig. 11.—Ground Plan of Generating Units.

Each of the machine panels has a double-pole circuit-breaker and two single-pole main switches. The equalizer switches on the instrument panel are separate and of the single-pole type. This arrangement enables the series-coil of a machine that is being started to be connected in multiple with one that is running, thus assisting the building up of the power much more rapidly. The main panel also contains an ammeter and a rheostat, and suitable provision is made for lighting the panel. One of the ammeters is of 1200 amperes capacity and the other of 750.

The feeder panels are connected to the generator panels by the positive bus bar only and each panel controls two feeders. Each feeder has on its circuit, in order, a choke coil to obstruct static discharges, a Walker quick-break switch, an ammeter and a circuit-breaker. The circuit branches to earth on the line side of the choke coil through a Garton-Daniels lightning arrester. The choke coils are made of heavy ¾-inch copper wire (see illustration.)

The instrument panel carries the general station instruments.

The board is arranged so that the circuit-breakers can be shunted with water rheostats. The panels are edged with angle irons and are fastened by bolting the projecting edges of the iron together, forming a T.

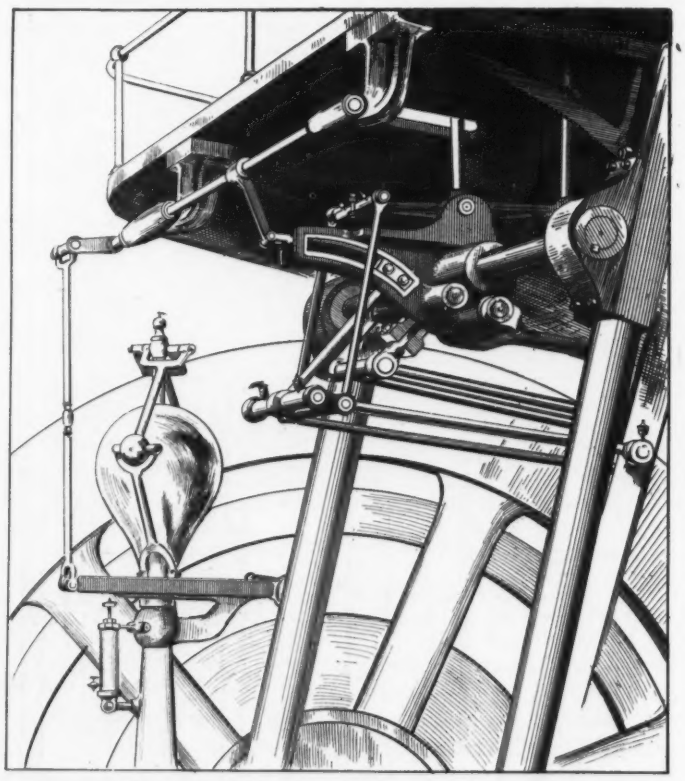


Fig. 12.—Details of Engine Governor.

The following named companies are represented in the construction of the apparatus used on this board: The Cutter Electrical & Manufacturing Company, Philadelphia, the circuit-breakers; the

Weston Electrical Instrument Company, Newark, N. J., the ammeters and voltmeters; the Ward Leonard Electric Company, Hoboken, N. J., rheostats, and the Garton-Daniels Electric Company, Keokuk, Ia., lightning arresters. The apparatus was specially made by these companies for the Walker Company and the board was designed and constructed at the latter company's New Haven works. Diagram illustrations of the front and back of the machine switchboard and of the feeder panels are here given.

Placed on the wall at the right of the switchboard is a 1200-ampere General Electric circuit-breaker and two single-pole knife switches, which are used for the purpose of effecting connection with the system of the Brooklyn Heights Railway Company in case the bridge plant should for any reason at any time be stopped. In this way in case of emergency the street railway current may be turned on to the bridge system, and it is expected that by this arrangement any temporary suspension in the power house may be tided over.

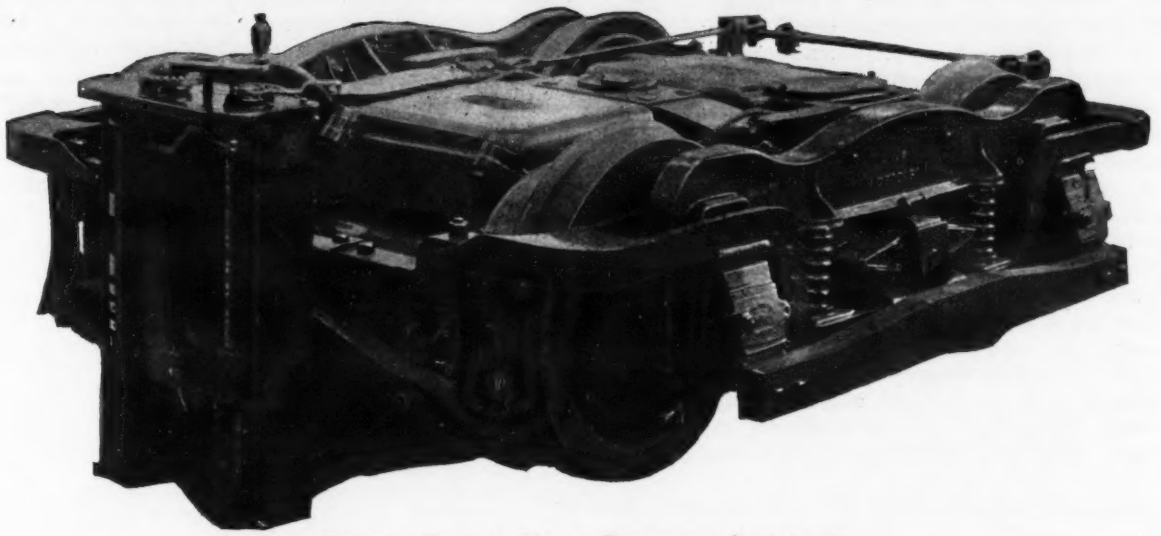


FIG. 13.—TYPE OF MOTOR TRUCK AND CONTROLLER.

THE ELECTRICAL DISTRIBUTION AND THIRD RAIL-SYSTEMS.

For the purpose of current distribution the bridge is divided into three sections, namely, the Brooklyn section, which embraces that part of the road from and including the Brooklyn station to the front end of the Brooklyn anchorage; the main section, which embraces the bridge structure itself, and the New York section, which covers the distance from the front end of the New York anchorage to and including the New York station. Six feeder cables are laid for the distribution of current to the three sections, the total length of the feeders being between 3½ and 4 miles. They were made by John A. Roebling's Sons Company, Trenton, N. J., and each has an area of 500,000 circular mils. They are laid parallel to the tracks on the top of glass insulators set on wooden cross-arms, and tied to the insulators so as to prevent their being displaced.

The feeders are numbered 1, 2, 3, 4, 5 and 6 respectively, Nos. 1 and 2 feeding the New York section, 3 and 4 the bridge proper, and 5 and 6 the Brooklyn section. In addition to these feeders there are four return conductors each of 500,000 circular mils.

The main feeders are tapped to the third rail at intervals of about 300 or 400 feet, No. 0000 wire being used for the purpose. The positive feeder bonds are of No. 0000 wire, and the negative return bonds are of No. 00.

The New York section, which embraces the distance from the New York station to the New York anchorage, is divided into six sub-sections, three on the north track and three on the south, the connections of all being controlled at a switch house located near the shed. A man who has the switches under his charge is stationed here at all times. One or more sections may be cut out at any time in order to remove all possible danger in case workmen are engaged on the track on any particular section, and when a train is approaching at such times all that is necessary is for the switchman to cut in the current long enough for the train to pass. At the Brooklyn end an exactly similar arrangement exists.

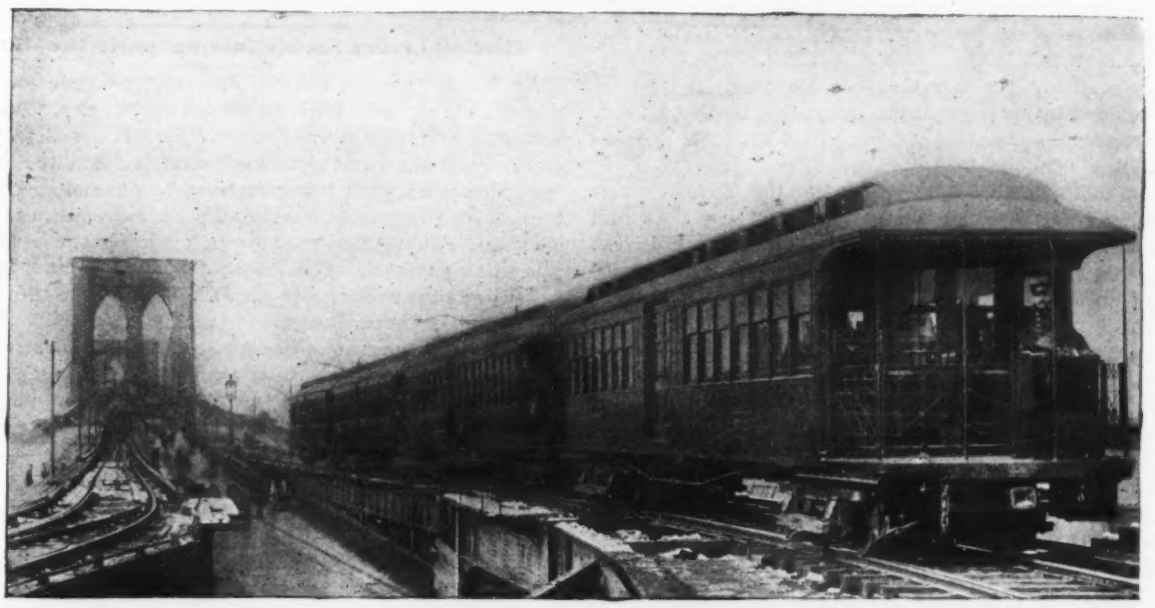


FIG. 14.—A BRIDGE TRAIN.

During the late night service, when it is the usual practice to run the trains one side of the bridge, the side not in use can be cut out of circuit, thus effecting a large saving of power.

The current for the operation of the motor-cars is taken from a third rail placed on the outside of the traction rails and parallel

thereto, all the way across the bridge, and at all crossings and switches about one foot from the outside rail. In one of the accompanying diagrams a plan of the switches at the New York station is shown, also the connections and locations of the third rail at the switching points. The third rail is the ordinary T-rail, bonded with No. 0000 bonds. The rails are laid on insulators, one of which is set on every fifth tie. The insulators are made of vitrified clay with a single petticoat, and are supported on iron pins passing through the tie. They are square, pyramidal in shape, the top of the pyramid carrying two jaws, which grip the base of the third rail, the jaws being screwed up by means of a bolt and nut. A perspective view and a cross-sectional view of the insulator are also shown here.

ELECTRIC MOTOR EQUIPMENT.

On Nov. 30, 1896, the electric switching of the trains at the New York and Brooklyn stations, from the incoming tracks to the outgoing tracks, was performed for the first time, and continued until Dec. 15, when an accident occurred at the power station of the Brooklyn City Railway, whence the power for the bridge switching operation was obtained. This accident deprived the bridge plant of its current, and the steam locomotives, which had been stored away, were hurriedly called into service. They will be used until the new bridge plant is in operative condition.

The motor cars are practically no different in appearance from the standard cars now used on the bridge, their length over all being 45 feet and weight with motors 30 tons. They are mounted on McGuire trucks made by the McGuire Manufacturing Company, Chicago, the same being especially designed for this service. Each truck weighs 10,000 pounds, and has a wheel base of 5 feet 6 inches.

The electrical equipment of each motor car consists of four G. E.-50 motors and two K 14 series-parallel controllers, both motors and controllers being especially designed to meet the peculiar requirements of the bridge traffic. The motors have the usual characteristics of all General Electric railway motors. Neither dust nor water can gain entrance to them. Each machine weighs about 3500 pounds, which is remarkably light weight for its power. The armatures are of the slotted core type, each winding lying in its own slot. Each coil can be removed and replaced easily with little or no disturbance of the others. The motors are suspended on springs, which affords a very flexible arrangement and largely prevents injury through jarring.

The series-parallel controllers are of the magnetic blow-out type. Each has 13 notches, six of the resistance points being in series and five in parallel. The handle is interlocking and cannot be moved unless the controller handle points to the "off" position. The controller stands 46¾ inches high, 22¾ inches wide and 10 inches broad and rests on the floor of the platform. Under each car are suspended 12 resistances of the packed-ribbon type set in open iron boxes, and under each platform is an automatic circuit-breaker which effectually protects the motors from a sudden rush of current. The break of the automatic circuit-breaker is set at 800 amperes. Additional protection is provided by cut-outs of the magnetic blow-out type. The circuit-breakers take the place of the main circuit hood switches and are worked in multiple instead of in series.

The duty these motor cars perform is to switch the four-car trains from the incoming to the outgoing platform at the New York and Brooklyn stations. When the trains are ready to start after the passengers have passed aboard, the motors will push them forward over the tilting sheaves where the cable will be taken up by the grips on the other three cars of the train. The conditions of the contract between the electrical company and the Brooklyn Bridge trustees require that in case of any failure on the part of the cable plant the four motors together shall be powerful enough to propel a fully loaded train, weighing 120 tons, across the bridge at the speed of the cable, namely, 11.3 miles per hour. The capacity of the motors is such that they will be able to haul the heaviest bridge trains up a 3.78 per cent. grade, not only for the 1000-foot grade of that percentage on the bridge, but the full length of Manhattan Island if necessary. One motor car is allotted to each train, forming part of the same and carrying its share of the passengers. It differs only from the ordinary car in that at the stations it performs the service that has been hitherto rendered by the steam switching locomotives. When the train is emptied at the terminal, the motor car draws or pushes it from the incoming platform to the tail track and thence to the outgoing platform. It then moves the train over the tilting sheaves so that the grips on the other three cars may seize the cable when the current is shut off, and the cable carries the train over the bridge structure to the opposite side.

During the early hours of the morning when the cable has stopped running and the travel is light, the motor cars will handle the entire traffic of the bridge. The motors will also help heavily loaded trains across the bridge and keep the grips from clipping the cable.

The current is taken from the third rail by four shoes on each motor car, two on each side. The shoes are suspended from a support set between the journal boxes of each truck, and are hung loosely from jointed to slotted hangers, and have an easy up-and-down motion as well. By this method of construction they take any angle within a wide range, follow the surface of the rail at all times and make perfect contact. The shoes are of cast iron about 12 inches long by 12 inches wide and 1½ inches thick, each weighing about 10 or 12 pounds. In practice one shoe is always in contact, whether the cars are passing the switches or other points where breaks in the third rail exist.

STATISTICAL.

In this connection a few statistics relating to the construction and operation of the bridge may be of general interest.

The construction of the bridge was begun	Jan. 3, 1870
Bridge opened to the public	May 24, 1883
Height of towers above high water	272 feet
Cubic yards of masonry in New York tower	46,345
" " " Brooklyn "	38,214
Diameter of suspension cables	15¾ inches
Miles of wire in the four cables	14,361
Weight of four cables	3,588½ tons
Weight of suspended structure	10,000 tons
Total length of bridge	6,016 feet
Width " "	86 feet
Height at centre above high water	135 feet
Original cost of structure, including land	$15,000,000
Railway opened for passenger traffic	Sept. 24, 1883
Time of crossing bridge by trains	6 minutes
Bridge made free to foot passengers	June 1, 1891
Length of power cable	12,000 feet
Diameter " "	1½ inches
Speed " "	11⅓ miles per hour
Estimated cost of recent improvements	$2,000,000
Maximum number of passengers carried in one month, *October, 1892	4,033,920
Total number of passengers carried from date of opening to close of 1896	435,150,309
Number of power cables used up to date	10
Greatest distance hauled by one cable	228,329 miles

* During the Columbian Festival.

During the first four months of the operation of the bridge railway (September, October, November and December, 1883), 1,682,740 were carried. Since that time the traffic has rapidly increased each year, the record of 1896 showing that 44,025,216 were transported across the structure in that year. From the date of the opening of the bridge railway up to the end of 1896 the total number of passengers carried was 435,150,309. In the transportation of this vast number of persons only two accidents occurred which resulted in severe or fatal injury—a record of which the trustees may justly feel proud.

Meeting of the Societe Internationale Des Electriciens.

At the meeting of the Société Internationale des Electriciens which took place in Paris on the 6th of January, M. L. Krieger described a new form of electric carriage. The model which had been constructed was a sort of hackney electric coach, the forward part of the ordinary carriage being replaced by a motor carriage. The latter consists of an axle carrying at either extremity an electric motor, each motor being connected through gearing at the ratio of 1 to 10 to a carriage wheel. The fields of the two motors are coupled in series and the armatures in parallel. In order to turn to the left or the right it is simply necessary to cut out one motor. This is effected very easily by means of a commutator under the control of the coachman. The first model contains accumulators weighing 285 kilograms and has a total weight of 1150 kilograms. With a complete charge the carriage can run 30 kilometres. The second carriage has been constructed for electric traction. This weighs empty 1860 kilograms and carries 640 kilograms of Julien accumulators consisting of 16 elements having a total capacity of 450 ampere-hours. The normal difference of potential is 30 volts at 50 to 60 amperes. In ascending slight grades the current runs up as high as 180 amperes. With a single charge the carriage can run 60 to 80 kilometres at a speed of from 10 to 12 kilometres per hour. M. Krieger announced that other carriages had been constructed and that he hoped to see before the end of the year electric hackney-coaches common features in Paris.

A continuation of the discussion on mechanical traction in Paris was carried on. M. H. Maréchal approved of the use of the overhead trolley for certain boulevards, and for large carriages in Paris he favored a mixed solution of the problem by employing overhead trolleys, accumulators and underground conduits.

Principles of Electrical Distribution.—VI.

BY FRANCIS B. CROCKER.

FEEDER REGULATION.

AUXILIARY bus bars are employed in stations or plants of any considerable size in order to avoid the loss of energy which inevitably occurs if "dead" resistance is used for regulation. This method is represented in its simplest form in Fig. 14, *C* and *D* being two dynamos, one of which *D* is connected to the main bus bar *F*, and generates the ordinary potential required to supply the shorter feeders or those which are lightly loaded, such as *B*. The other dynamo *C* runs at a higher voltage, and is connected to the auxiliary bus bar *E* for supplying the longer or more heavily loaded feeders, represented by *A*. The scope for regulation is still further increased by varying the pressure at either or both of the bus bars. This may be accomplished by hand or automatically, rheostats in the shunt field circuits of the dynamos, compound winding, or other well known means for controlling the E. M. F. of dynamos being employed for the purpose. It is evident that any number of bus bars may be used, being supplied with current by dynamos running at different voltages, and

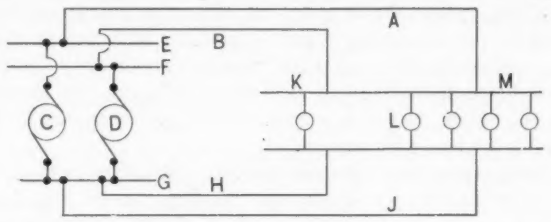


FIG. 14.—FEEDER REGULATION WITH AUXILIARY BUS BARS.

two or more dynamos may be operated in parallel on any bus bar, in accordance with the demands for current. It is also obvious that several feeders may be connected to one bus bar. Each feeder is provided with switches that connect it to any particular bus bar according to the load upon it.

A transfer bus bar is used to enable a feeder to be gradually shifted from one bus bar to another without the sudden variation in potential which would occur if it were thrown over directly by means of the switches mentioned above. This arrangement is indicated in Fig. 15, being similar to that shown in Fig. 14, but having a transfer bus bar *P* in addition to the main and auxiliary bars *F* and *E*. The latter is connected to the resistance *T* of a rheostat, the movable arm *V* of which is connected to the transfer bar *P*. The operation of shifting the feeder *B* from the main bus bar *F* to the auxiliary *E* when its load becomes large, is as follows: The feeder *B* is connected to the transfer bar at *P*, the rheostat *T* being previously open-circuited. The arm *V* is then moved clockwise until it comes in contact with the extremity of the resistance *T*. This connects the feeder *B* with the auxiliary bar *E* through the whole of the resistance *T* which allows a certain current to flow from *E* into *B*, the former having a

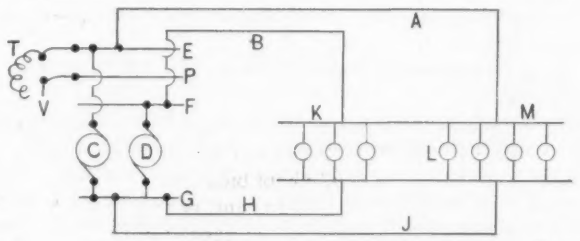


FIG. 15.—FEEDER REGULATION WITH TRANSFER BUS BARS.

higher potential than *F*, to which *B* still remains connected. The resistance *T* is then gradually cut out by the further movement of the arm *V* until the current supplied from the auxiliary *E* to the feeder *B* is equal to the load carried by the latter, when the connection between *B* and the main bus bar *F* is opened. The remainder of the resistance *T* is then cut out, which directly connects the feeder *B* with the auxiliary bar *E*, the transfer having been made without any disturbance of the system. In performing this operation the amounts of current are ascertained by having an ampere-meter inserted between *T* and *E* in addition to the ampere-meter that should always be placed in circuit with each feeder. The difference of potential between the feeders, bus bars, etc., should also be indicated by voltmeters. The necessary instruments are assumed to be present in every case, but are omitted from the diagrams to avoid confusion, as they perform no active part in the operation of the system, their only function being to give information.

Where two or more feeders run to the same main and are provided with rheostats, one of them may be disconnected or transferred from one bus bar to another by first cutting in all the resistance of the rheostat in order to reduce the current and then opening the switch. The drop on a feeder being usually only a few volts, its circuit may be opened with practically no greater flash than is produced by any other circuit having a voltage equal to this drop, provided the remaining feeders are sufficient to carry the current without materially increasing the fall of potential upon them.

The use of "boosters" for regulating electric light feeders, etc., has quite recently become an important and successful feature of electrical installations. The principle of this method is represented in Fig. 16, in which *D* is the main dynamo generating the greater part of the electrical energy, and *R* and *S* are two small auxiliary dynamos called "boosters," connected in series with the dynamo *D* and the two feeders *A* and *B* respectively. Assuming that the main dynamo *D* generates a constant voltage, the variation in pressure required to regulate the feeders in accordance with the changing loads upon them is obtained by controlling the potential of the boosters *R* and *S*. This is usually accomplished by exciting the field magnets of each booster from the dynamo *D*, a rheostat being

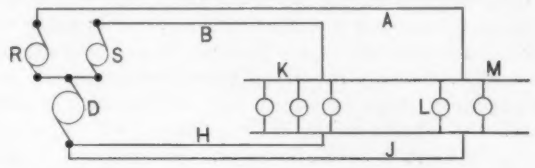
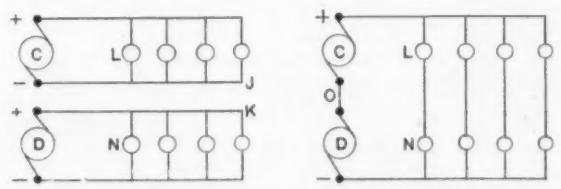


FIG. 16.—FEEDER REGULATION BY MEANS OF BOOSTERS.

inserted in the circuit. Another plan is to provide the boosters with series-wound field magnets, in which case the voltage generated by each increases with the current flowing through it. With field-magnets designed to work well below magnetic saturation, this gives an automatic regulation which is almost perfect, since the extra pressure produced by the booster may be made to exactly overcome the drop on the corresponding feeder for all loads, or it may be designed to also make up for some or all of the drop on the mains and leads. This method is quite similar in principle to compound-wound dynamos, but it acts upon the feeders individually, instead of upon the system as a whole. The main dynamo and the boosters may all be driven by one or more steam engines or other prime mover, or the boosters may be operated by electric motors supplied with current from the main dynamos. Boosters are sometimes used to reduce the voltage instead of raising it, in which case the main dynamo may be run at the average pressure required by the feeders, the potential in those that are heavily loaded being increased and depressed in the lightly loaded ones. A booster which lowers the voltage by generating a counter E. M. F. acts as a motor and tends to develop power; consequently, if it is coupled with another booster it will drive it as a dynamo, provided that the energy absorbed by the former is slightly greater than that produced



FIGS. 17 AND 18.—EVOLUTION OF THE THREE-WIRE SYSTEM.

by the latter, in order to make up for mechanical and electrical losses in both machines.

Instead of having a separate booster for each feeder, as indicated in Fig. 16, two or more feeders requiring approximately equal voltages may be supplied from the same booster. In this way a large number of feeders may be regulated with only a few boosters, which are run at different potentials, the feeders being divided among them according to the extra pressure required. This is practically equivalent to a system having several auxiliary bus bars supplied with different voltages. In Fig. 14, for example, the dynamo *C* might be omitted and the higher voltage required for the auxiliary bus bar *E* could be obtained by connecting a booster between *E* and *F*. This is a more convenient arrangement in some cases, particularly

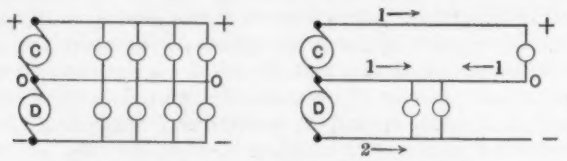
in small plants, since it would only be necessary to run one main dynamo, the booster being drawn by a motor.

ACTUAL CONSTANT-POTENTIAL SYSTEMS.

Practically all two-wire constant-potential systems of distribution, including those for electric lighting. power and railway purposes, consist of combinations of the arrangements of circuits and methods of regulation that have been described. The three-wire system and other special methods will next be considered.

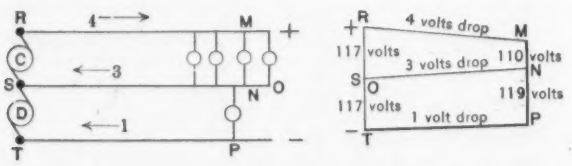
THREE-WIRE SYSTEMS.

The three-wire system which was independently invented by Edison and Hopkinson has for its object the saving of copper in distributing conductors. Until quite recently it was not considered prac-



Figs. 19 and 20.—Three-Wire Systems.

ticable to use incandescent lamps designed for a pressure higher than 120 volts. This limited the potential at which parallel systems were operated and necessitated conductors of large size and weight, particularly when the current is transmitted any considerable distance, as already shown in the examples given. When it is attempted to supply incandescent lamps in series difficulties immediately arise, due to the dangers of high potential, the interference between the lamps and the imperfection of regulation, all of which were noted under the head of Series Systems. The principle of the three-wire arrangement may be understood by first considering two entirely distinct two-wire circuits, as represented in Fig. 17. If the lamps *L* and *N* happen to be placed in the manner shown, it is evident that they may be connected in series of two each, as illustrated in Fig. 18, in which case the intermediate wires *J* and *K* become superfluous and are omitted. But when one of the lamps is turned off or burned out, its companion will also go out, hence a third wire, indicated in Fig. 19 by a dotted line marked *o*, is extended from the junction between the two dynamos *C* and *D*, in order to avoid this difficulty. This allows any number of the lamps to be disconnected without putting out those which remain. The extra conductor is called *the neutral wire*, and is usually marked *o* or ±, the latter symbol representing the fact that it is positive with respect to one conductor and negative with respect to the other. The neutral wire carries no current if the system is exactly "balanced" (Fig. 19), but when the amounts of current on the two sides of the system are not the same it supplies the difference, whatever it may be, as represented by arrows and numbers in Figs, 20 and 21, each lamp being assumed to take one ampere. It should be observed that the flow of current may be opposite in direction in different parts of the neutral wire (Fig. 20). Another peculiar condition in three-wire circuits is the fact that the potential at certain lamps may actually be lighter than that of the dynamo on the same side of the system. This is demonstrated in the potential



Figs. 21 and 22.—Three Wire System.

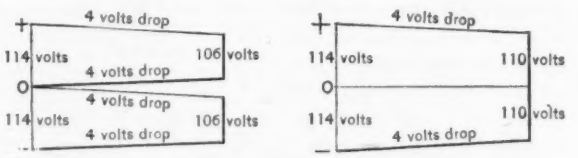
diagram (Fig. 22), corresponding to the arrangement of lamps shown in Fig. 21. Assuming the resistance of each of the three wires to be 1 ohm, the drop on the + conductor between *R* and *M* will be 4 volts with a current of 4 amperes. The drop between *N* and *S* on the neutral wire will be 3 volts, since 3 amperes flow back through it. With a potential of 117 volts at each dynamo, this gives 110 volts for the lamps between *M* and *N*. The drop on the — wire between *P* and *T* is 1 volt, hence the potential of the point *S* is 1 volt above that of *T*, but as *N* is 3 volts higher in potential than *S*, it follows that the pressure between *N* and *P* is 2 volts greater than that delivered at *S* and *T* by the dynamo *D*. Therefore, the lamps at *M N* receive 7 volts less pressure and the lamp at *N P* 2 volts more pressure than the potential difference at the dynamos.

Advantages and Disadvantages of the Three-Wire System.—The sole merit of this arrangement is the fact that it saves copper, the amount of this saving being determined as follows:

The circuit represented in Fig. 18 has two wires, while those in Fig. 17 employ four, hence the former requires one half as much copper as the latter, assuming the size of the wires to be the same. Furthermore, the percentage of drop in Fig. 18 will only be one half as great as that in Fig. 17, the explanation of this fact being given in Figs. 23 and 24, which show the distribution of potential in the two cases. In the two-wire circuits (Figs. 17 and 23) there will be a drop of four volts on each wire, assuming four amperes of current and one ohm resistance for each, and the lamps will receive 106 volts with a pressure of 114 volts at the dynamos, the drop being $\frac{8}{114}$, or 7 per cent.

The lamps on the three-wire circuits (Figs. 18 and 24) receive 110 volts with the same initial potential, *i. e.*, 114 volts, the drop being only $\frac{4}{114}$ or 3.5 per cent., or one half as much as in the previous case. It follows therefore if the wires in Fig. 18 have one half the cross-section of those in Fig. 17, that the percentage of drop will be the same for both. Consequently Fig. 18 requires one half as many conductors of one half the size, on only one quarter as much copper as Fig. 17. If now the neutral conductor in the three-wire system (Fig. 19) be made the same size as each of the outside wires, the weight of the copper will be $\frac{1}{4} + \frac{1}{8} = \frac{3}{8}$ as much as in the two-wire circuits (Fig. 17), supplying the same number of lights at the same distance. Since the neutral wire usually carries only a small current, it is often made one half as large as either of the outside conductors, in which case the weight of copper becomes $\frac{5}{16}$ that demanded by the two-wire system.

The great saving in copper, amounting ordinarily to $\frac{5}{8}$ or 62.5 per cent. is considered of such paramount importance that the three-wire system is almost always adopted in electric lighting for low-tension distribution wherever the distances are considerable. In the case of low-tension central stations this custom is practically universal, and even for large isolated plants the three-wire system



Figs. 23 and 24.—Advantage of Three-Wire System.

is often selected. It is also employed for the secondary wiring in alternating current distribution with transformers. The object in all cases is to save copper, which, as already stated, constitutes such a large item in the cost of nearly all electrical installations.

To offset this advantage, however, the three-wire system has the following disadvantages:

1. It is usually necessary to operate at least two dynamos or other sources of current.

2. It is necessary to lay and to take care of three wires instead of two.

3. The switches, cut-outs, measuring instruments, etc., are also more complicated.

4. The saving of copper stated assumes that the neutral wire carries no current.

But if all the lamps happen to be in use on one side of the system only, the copper should be the same as for a two-wire circuit. Even though the system be carefully kept balanced so that the current in the neutral conductor is only 10 per cent. of the total, the saving of copper would be reduced from 62.5 to about 50 per cent.

5. The *variation* in potential is aggravated by the increase that sometimes takes place (Fig. 22), which is impossible on a two-wire circuit.

When all these objections are considered it is somewhat doubtful if the reduction in the weight of copper makes up for them in some cases where the three-wire system is adopted. There is a strong tendency on the part of the purchaser, consulting engineer and contractor to give too great weight to the matter of first cost and too little heed to questions of convenience, labor involved, liability of accidents and many other factors that make up running expense. The three-wire system is unquestionably more complicated and difficult to install or operate, and it should not be selected unless the saving that it secures is surely sufficient to pay for these disadvantages. For low-tension distribution to distances of a mile it is practically necessary to employ it, but for isolated plants, where the

length of wires is only a few hundred feet, its superiority is by no means so certain, in spite of the very powerful argument which the difference in the cost of copper makes.

The recent improvements in and applications of 220-volt incandescent lamps renders the three-wire system considerably less important than formerly, since it enables a two-wire circuit to be operated at 220 volts, the copper required being only two thirds as much as for the ordinary three-wire system. To be sure, the latter can now be run at 440 volts, giving it the same relative advantage as before, but it is doubtful if such a high voltage is desirable for general use.

(To be continued.)

Distribution and Diffusion of Light.*

BY E. L. ELLIOTT.

We may, for convenience, divide the subject of artificial lighting into five different sections, *viz:* 1, intensity, or brilliancy; 2, distribution; 3, diffusion; 4, quality; 5, efficiency.

The average brilliancy of illumination which will be most desirable will of course vary somewhat with the use to which it is to be put. A "dim religious light," that would be very satisfactory for a church, would be wholly inadequate for a library, and equally unsuitable for a ball-room. For general purposes it is safe to say that the intensity must nowhere be less than one candle-foot, and twice this brilliancy is undoubtedly better. With our present means of producing intense light, it is quite possible to exceed the limits of effective illumination, and produce a glaring intensity, which is a serious error, both from the æsthetic and physiological standpoints.

The distribution of light involves two quite distinct problems, *viz.:* First, the distribution of the several units into which the general source is to be divided, and, second, the distribution of the rays from the individual units. The first of these problems contains as a determining factor the illuminating, or "candle-power," of the light-units adopted. The determining factor in the second problem is the nature of the light-source itself. The result desired is in nearly all cases the same, to secure a uniform brilliancy in a certain plane or within a given space. A room uniformly lighted, even though comparatively dim, gives an effect of much better illumination than where there is great brilliancy at some points and comparative darkness at another; the darker parts, even though actually light enough, appear dark by contrast, while the lighter parts are dazzling. For this reason naked lights of any kind are to be avoided, since they must appear as dazzling points, in contrast with the general illumination.

Aside from difference in intensity, light produces many different

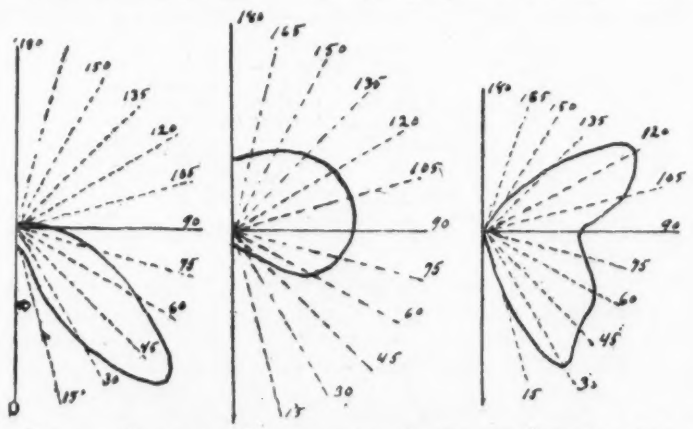


FIG. 1.—CURVES OF DISTRIBUTION. I, DIRECT CURRENT ARC. II, FLAME. III, ALTERNATING ARC.

effects upon the optic nerves and their centres in the brain. These different impressions we ascribe to difference in the *quality* of the light. Thus "hard light," "cold light," "mellow light," "ambient light," etc., designate various qualities. Quality in light is exactly analogous to *timbre*, or quality in sound, which is likewise independent of intensity. The most obvious differences in quality are plainly those called color. But color is by no means the only element of quality. The proportion of invisible rays, and the state of diffusion, are highly important factors; but on account of not being directly visible, they have been generally overlooked and are but imperfectly understood. It may be safely said that all rays on either side of the most plainly visible part of the spectrum are injurious to the eyes. The light of the electric arc has a very large excess of violet and ultra-violet rays, which injures the quality very greatly. Gas flames, on the other hand, have an excess of infra-red, or heat rays, which likewise injure the quality. I have heard the same charge made against the Welsbach light, but have not yet been able to verify it. The absorption of these extra-spectral and injurious rays by suitable transparent screens is undoubtedly feasible, but seems never to have been even suggested.

The importance of diffusion has also been greatly neglected. We must keep in mind the distinction between diffusion and distribution. Distribution refers to the intrinsic brilliancy of illumination at every point in the given space; diffusion refers to the number of rays that cross each point. The amount of diffusion is shown by the character of the shadow. Daylight on a cloudy day may be considered perfectly diffused; it produces no shadow whatever.

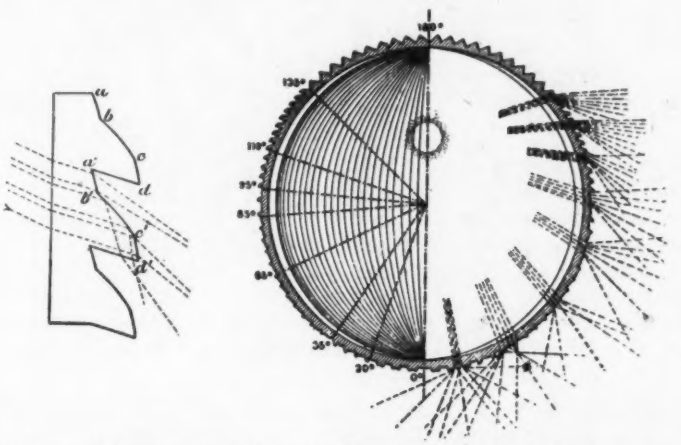


FIG. 2.—MERIDIANAL VERTICAL SECTION OF HOLOPHANE GLOBE.

The light from the electric arc is least diffused, since it emanates from a very small surface; the shadows cast by it have almost perfectly sharp outlines. It is largely due to its high state of diffusion that daylight, though vastly more intense than any artificial illumination, is the easiest of all lights on the eyes. The eyes should be subjected as little as possible to the direct rays from any light source. It is a common and serious mistake in case of weak eyes, or over-strained eyes, to reduce the intensity of the light instead of increasing the diffusion. The eye is made to receive light and like any other organ is strengthened by use. To attempt to strengthen weak eyes by reducing the light is like attempting to strengthen your arm by putting it in a sling. Farmers who are continually out in the brilliant sunlight are almost entirely free from weak eyes. An abundance of light of the right quality is what the eye needs.

The efficiency of a light-source is the ratio of the energy given out as light to the total energy consumed. All our present means of producing light are wasteful in the extreme, the efficiency probably never exceeding 5 per cent., and half that being nearer the average. The production of light without heat is one of the dreams of the physicist, and will probably some day be realized. But while we are compelled to use the present wasteful methods of generating light, it is the more important that care be taken to secure the greatest possible illumination from any given source. There has been almost a total neglect, on the part of those whose business it is to know, of the general principles of utilization of artificial light. It is the chief purpose of this paper to briefly set forth these principles, and review the various attempts that have been made to apply them to practical use.

The lighting engineer—a hypothetical personage whom we hope will actually exist some day—has at his disposal five different light sources—*viz.*, the oil lamp, gas flames, incandescent gas, incandescent electric and electric arcs. With the exception of the incandescent electric, all these must be placed in a vertical position, and except the electric arc cannot be inverted. Now, it is a common idea, due to some extent perhaps to a careless statement in the text books—to wit: "from a given source light proceeds equally in all directions," that such is actually the case, when in fact it is not the case at all. Each source of light distributes its rays according to its own peculiar law. These laws are most easily expressed as polar curves, which are given in Fig. 1, the plane of the curve being vertical.

It will be observed that the lights produced by gas and oil send a

* Abstract of a paper read before the New York Electrical Society.

large part of their light upward: the direct current arc sends most its light downward, the larger part included between the angles of 30 degrees and 50 degrees; while the alternating arc sends its light equally upward and downward, but mostly between the angles of 50 degrees above and below the horizontal. While the distribution from the incandescent electric is by no means uniform, it is of less importance, since the lamp may be placed at any angle. With the exception of the flat flame, the distribution of all these sources in a horizontal plane may be considered uniform.

The objects which we wish particularly to illuminate are generally below the level of the eye, as reading matter, or articles being

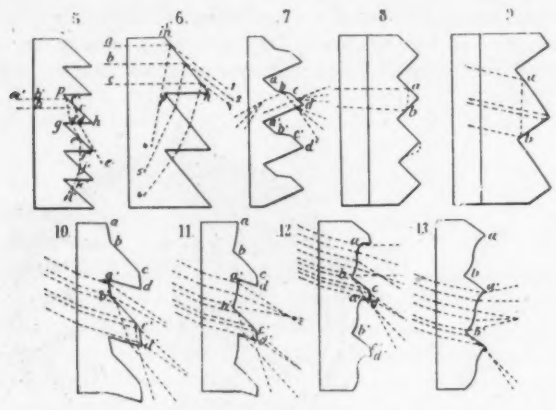


Fig. 3.—Various Forms of Profiles of Exterior Rings, Showing Reflecting and Refracting Surfaces.

worked at with the hands. In practically all cases they are below the sources of light. The first step toward efficiency and economy will be therefore to direct the larger part of the flux of light below the plane of the source. In exterior lighting we may consider all light above this plane as absolute waste.

The prime requisite of illumination is, as already stated, that it shall be uniform. Whatever source of light is to be used therefore a better distribution must be obtained, if economy is to be considered. Having secured this result to as great a degree as possible, the problem then becomes comparatively simple. Knowing the illuminating power of the sources to be used, the general brilliancy

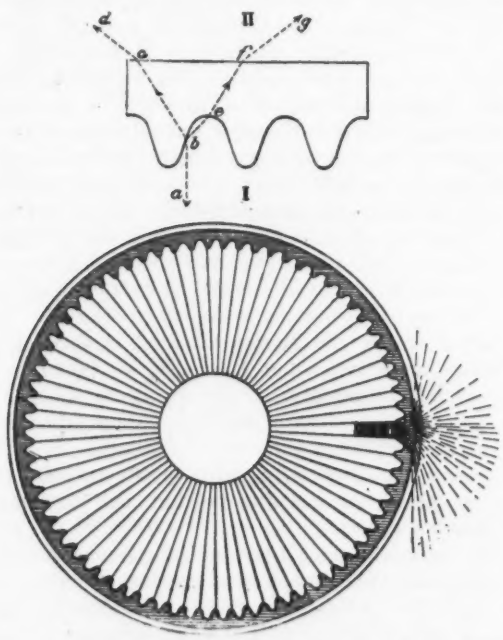


Fig. 4.—I, Equatorial Section of Holophane Globe. II, Portion of Section Enlarged, Showing Form of Interior Grooves.

to be required, and the extent of space to be illuminated, the distribution of the light unit is readily determined.

The intelligent engineer will now look to the *quality* of the light. In this regard we can do little more at present than to provide the most economical means possible for the diffusion of the luminous rays, leaving no naked light sources visible. In case arc lamps or Welsbach burners were to be used for interior lighting, he would doubtless seek to reduce the excessive blue and violet of the former, and the yellowish green of the latter, by means of suitably tinted globes.

For securing a better distribution and diffusion of the light, advantage must be taken of the well-known properties of refraction and reflection. In diverting the upward flux into the lower hemisphere, reflection is, within certain limits, the only means possible. Regular reflectors, either of silvered glass or polished metal, have long been used for this purpose; but they have several serious defects. Glass is fragile, polished metal tarnishes, and neither produce any diffusion, but rather increase the glare. Irregular reflecting surfaces, as the so-called porcelain and white enameled metal, correct some of these defects. and give about an equal efficiency, reflecting about 80 per cent. of the incident light.

The most common method of securing diffusion, and partially correcting the distribution, is by means of globes, either roughened on the surface by sand-blasting or etching, or rendered translucent and milky in the process of manufacture, "opal," or "opaline" glass. While the diffusion produced by these means is good, the method is extravagantly wasteful. Clean ground glass will absorb 30 per cent. to 50 per cent. while opal glass absorbs from 50 per cent. to 80 per cent. of the light.

Besides this loss by absorption, such glass causes an additional practical loss by diverting more light into the upper hemisphere, when used with the arc light. In this case the globe itself becomes the practical source of light, each point on the surface giving out light in all directions, outside the tangent plane. With the direct-current arc most of the light would fall on the lower half of the globe; but for the reason just given, this lower half would throw considerable light in the upper hemisphere which would otherwise continue its downward course. The higher the arc is placed in the globe, the greater the loss in this way.

On account of the serious objections to the means just described various attempts have been made to secure better results by the systematic use of refraction and total reflection. Ribbed glass was the earliest attempt in this direction, and its use is very old. Glass of this kind was used in the electric lanterns in the streets of London. Mr. Edward Atkinson has recently revived interest in the use of such glass by applying it to the windows of factories. The results were very satisfactory, the corners and spaces between the windows being much better illuminated.

The next step was the use of two such panes placed together, with the flutings crossed at right angles, suggested by Raffard in 1881. This was simplified by Trotter in 1883, by rubbing a single sheet of glass on both sides, a method which Cooper and Richardson had suggested 10 years before. The method is still quite commonly applied to lamp "shades," or globes. Seaver has brought out a globe having

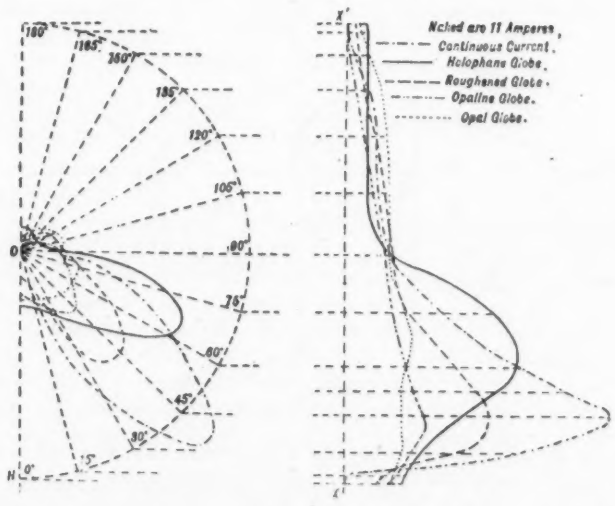


Fig. 5.—Curves of Distribution and of Flux, of Direct-Current Arc, with Various Globes.

interior meridianal prisms, which have the effect of widening the apparent source of light. As might be expected, they show the prismatic colors at the edges of the light. Shades having similar prisms on the outside are also to be found, and produce a similar result.

An attempt has been made to apply this principle to *blown* glass

lamp chimneys, but as the process of blowing is incapable of producing appreciable variations of thickness, it is evident that such attempt must be practically useless.

The idea of giving a special form to the ribs or flutings, so as to distribute the light according to a predetermined law, was suggested by Fresnel more than 50 years ago, and has been very highly developed for light-house purposes. Comparatively little attention, however, has been given to applying the principle to the problem of securing a better distribution for general illumination.

In 1883 Mr. A. P. Trotter, an English engineer, devised a lantern with panes of glass having flutings, the profiles of which had been calculated with a view to giving uniform illumination on a horizontal plane. Although the results were remarkably good, the expensiveness of the device seems to have prevented its adoption. More recently Fredureau has constructed globes with simple prismatic or parabolic external zones, simply to reflect as much of the light downward as possible. They are properly reflectors and produce no diffusion.

The latest attempt of this kind is the globe brought out by Messrs. Blondel and Psaroudaki, of Paris. These globes are provided with horizontal exterior rings and vertical meridianal groovings, the profiles of both being calculated mathematically, according to the laws of optics, so as to give the best distribution, with ample diffusion.

The two sets of grooves and projection are so formed as to make the entire globe appear luminous, from which fact the inventors have given them the name "holophane," signifying wholly luminous. So ingeniously have the laws of optics been applied to the practical solution of this important problem that a description of the globes will doubtless be of general interest.

The method of designing them is as follows: The general contour of the globe or envelope is first determined, which may be of any desirable form consistent with the process of manufacture. As an example let us suppose that a spherical form is chosen, Fig. 2. The location of the source of light is then decided upon, in this case being generally placed a little above the equator. Since the source of light has more or less surface, it is sufficiently accurate to consider the incident rays on a small section of the surface as parallel, and the surfaces of the section planes. The problem requires that we should deflect each beam in the most advantageous direction, and at the same time spread it out so as to secure diffusion. Theoretically we might accomplish this by giving each section of the exterior surface a simple, convex or concave profile. But, by such construction, a portion of the beam, striking the surface at a large angle, would suffer a considerable amount of reflection, the reflected portion being lost in the upper hemisphere. In order to avoid this loss

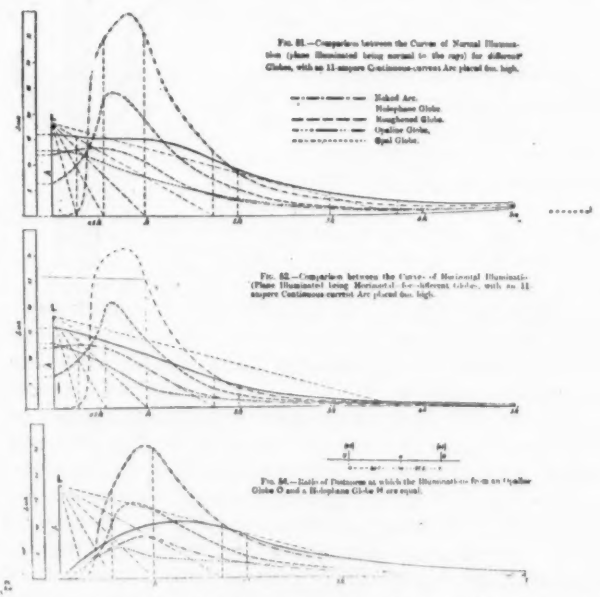


FIG. 6.—CURVES OF ILLUMINATION OF DIRECT-CURRENT ARC, WITH VARIOUS GLOBES.

a surface placed at the angle of total reflection $b' c'$ is substituted for a part of the refracting curves. By properly calculating these curves, which is done by the use of mathematical formulæ too long to be given here, the beam may be spread out so as to secure the desired distribution and diffusion, with a minimum of loss. In a similar manner the entire surface of the globe may be divided into such rings, each having its profile so calculated as to distribute the light over the same solid angle, and hence appearing luminous in the line of sight to an eye situated anywhere within the angle. The dividing lines $a\ d$ between the rings are made as nearly as possible in the direction of the incident rays. Theoretically, each ring should have a different form, due to the different direction of the incident rays; but in practice it is sufficient to divide the periphery into a number of zones, each zone having a special form of ring, as shown at the left side of the section, Fig. 2. Near the top of the globe the rings have the form of doubly reflecting prisms,

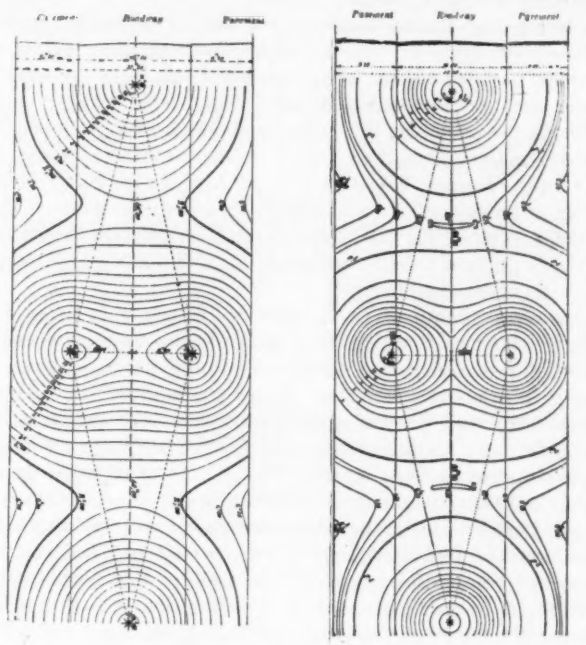


FIG. 7.—DISTRIBUTION OF ISOLUX LINES. I, WITH HOLOPHANE GLOBES. II, WITH OPAL GLOBES.

which deflect the light downward through the lower portion of the globe. Great variety in the profile of the rings is possible. Some characteristic forms are shown in Fig. 3.

A globe thus constructed with only horizontal groovings or rings will give only vertical spreading, and so appear luminous only in a vertical meridian. To secure lateral spreading of the light, the interior surface is formed of a series of meridianal grooves, from top to bottom, Fig. 4. These grooves all have the same profile since all sources of light give out their rays with practical uniformity in all directions laterally. The curvature of these interior flutings is therefore so calculated as to spread the beam out as nearly as possible over a solid angle of 180 degrees, *i. e.*, tangent to the surface. Furthermore the curve is calculated to distribute the light according to the law of cosines, so that each meridian shall appear equally luminous when viewed from every point. Of the many curves which would fill these conditions theoretically, the one shown has been selected as having the greatest practical advantage.

The effect of diffusing globes is to make the source of light appear larger. If the diffusion is perfect, the entire surface of the globe becomes luminous, as in the case of opal and ground glass. Of all the variously ribbed and corrugated globes made of clear glass, the holophane is the only one which attains this perfection.

Photometric comparison of the results obtained with the various globes when used with a direct-current arc lamp have been made by Blondel and others, the results of which are very instructive. Fig. 5 gives the curves of distribution, and also of flux with an arc used with the several globes named. Fig. 6 gives the curves of illumination. Fig. 7 gives the distribution of the isolux lines on the pavement of the Paris boulevards under two different kinds of globes.

From these curves it will be seen that a better distribution, coupled with a satisfactory diffusion, is secured, with considerably less loss of light, by the holophane globe than with either ground glass or opal globes. It is to be hoped that experiment and investigation on these lines will lead to even better results, and to a more general appreciation of the importance of a proper use of our splendid modern light sources.

The Enclosed Arc Light.*

BY L. B. MARKS.

THE unprecedented industrial utilization of the enclosed arc light in America during the past two years has aroused the attention not only of American electricians and engineers, but of scientists the world over. Although some of the earlier inventors in this field achieved a modicum of temporary success, every attempt to introduce the enclosed arc lamp commercially eventually met with decided failure.

Before going into the details of the subject or presenting a sketch of the earlier history of the art of enclosed arc lighting, it may not be amiss to point out the characteristic distinction between the ordinary arc and the enclosed arc. The ordinary arc, commonly known as the open arc, is generally enclosed in a globe more or less tight at the top and bottom. This is also the case with the enclosed arc. In the former, however, the arc depends for its efficient operation upon an excess of air or oxygen-bearing gas, while in the latter provision is made for the partial or total exclusion of the atmosphere. With this preface I shall now revert for a few moments to the earlier forms of enclosed arc lamps.

Historical Sketch.—The history of the art may be said to date back to about 1846, when Mr. Wm. E. Staite first produced an enclosed lamp in which one carbon was supported on a rod passing through an air-tight bushing into a globe, and the other carbon mounted in a tube projecting through the base of the globe, and fed by a rack operated by clock-work. In this lamp the arc was struck by pushing the carbons apart by hand. At that early date Staite pointed out that "the more rarified or de-oxygenated the air around the point of ignition is, the more continuous and brilliant the light; hence, may be deduced the propriety of enclosing the electrodes in a vessel of small dimensions, hermetically sealed from the external atmosphere, but with a valve in it for the escape of the included air when the expansion begins to exceed those limits which experience may show to be compatible with the safety of the apparatus."

About a year later Staite improved this lamp in various details. Instead of springing the arc by hand it was done automatically by an electro-magnet. The arc was inclosed in an air-tight globe and the regulation effected by the electro-mechanical means.

After Staite's experiment there followed a period of inactivity in this line, and it was not until the seventies that the work was again zealously taken up. In 1878 F. H. Varley brought out a lamp containing an air-tight chamber, in which carbon powder was allowed to fall from one electrode to another as from an hour glass, the carbon being heated to incandescence in transit. The mechanism of the lamp was so arranged that the carbon, after falling through the arc space and becoming incandescent, was again returned by suitable carriers to go through the same operation. In 1879 George G. André devised an electric lamp in which the carbons were enclosed air-tight in a large globe, no provision having been made for egress or ingress of gases. The oxygen of air in the globe gradually combined with the volatilized carbon when the lamp was in operation, until finally the electrodes burned in an atmosphere consisting largely of carbon gas.

About this time there was considerable activity in the production of enclosed arcs of a different type—*viz.*, the semi incandescent arcs. In this form the carbons or other electrodes, as the case may be, are in imperfect contact, the point of juncture being heated to a state of incandescence when the current is passed. Such was the lamp of Brougham, in which the carbons were enclosed in a receptacle from which the atmosphere was excluded; no arc was sprung in this lamp, the light emanating from the incandescent points. Following closely on this, in the year 1880, André and Easton produced a lamp similar to the older type already described, but different from the latter in that the movable carbon was maintained in contact with the negative in a closed chamber, and was fed upward as the carbons burned away, the feed being effected by a weight released by a magnet acting on a friction disc. The same type of lamp is also described by Hedges, who substituted a metal disc for the negative carbon, the positive carbon feeding and continuously bearing against this metal disc and heating the joint to incandescence.

The well-known lamp of Werdermann which was brought out in 1882 is another type of the typical incandescent arc. In Werdermann's lamp the carbons were enclosed in an air-tight globe. A thin carbon pencil was propelled against a large negative electrode by a spring, the pencil passed through a block of magnesium or other refractory substance and a considerable length of the electrode between the block and the contact was rendered incandescent. After the lamp was started the oxygen contained in the globe quickly combined with the carbon, the residual gases thus consisting of nitrogen and carbonic oxides. Among the other lamps of the same type in which no true arc was sprung were the earlier forms of Janson in 1875 and Scott in 1878, and subsequently those of Rapieff, Nordenfeldt, Pilleux and Quesnot.

The record of development between 1880 and 1884 shows that a number of lamps of the enclosed type, in which a true arc was sprung, were produced. The principal ones were that of Varley, in which the arc was enclosed in a glass globe or shade filled with carbonic anhydride, or hydrogen, or dried nitrogen; those of Wallace, Brewer and Menges, that of Beardslee, in which the arc was enclosed in a small globe, air-tight at the bottom and having a contracted neck at the top, through which the movable carbon passed; that of Baxter, in which the entire lamp mechanism was enclosed air-tight, provision for the egress of heated gases under pressure being made by suitable valves connecting the enclosure with the outer air, and that of Short, similar to the last. Besides these there were several others, differing from those cited only in detail.

The Enclosed Arc in America.—In America the first attempts to utilize the enclosed arc in commerce date back to the early eighties, when Beardslee produced an enclosed arc, and Wm. Baxter experimented with long-hour enclosed lamps. Baxter's experiments and tests covered a period of years, but resulted in failure. From time to time other inventors took up the subject, but as the ground covered by them differs very little from that of earlier efforts, it will not be necessary to dilate here upon the various schemes attempted since the original presentation of the Beardslee and Baxter lamps respectively. This brings us to the time when Howard took up this line of work in conjunction with me about five years ago. Most of you are familiar with the tests reported by me at the International Electrical Congress at Chicago, in August, 1893. This paper was hastily prepared to present a subject which, in the opinion of those who had witnessed the trials, was deemed worthy of the fullest description possible at the time. The arrangement of parts disclosed in the lamp referred to in the paper at Chicago was rather unique in some details, but in principle did not differ essentially from earlier forms. It was thought at that time that the enclosed arc would have a large field on constant-current circuits, and an attempt was made to equip existing lamps with the enclosing device. This device, which was very crude, consisted of a cylindrical glass receptacle clamped by discs which pressed tightly against its upper and lower edges respectively, the lower end being closed air-tight, and the upper end provided with an opening through which the positive carbon passed. In this equipment the negative electrode was made of metal. I shall have occasion to allude to this metal negative later on; also to point out the prime cause of failure in this as well as in many of the other forms of enclosed arc herein referred to. Subsequently another device was used which consisted simply of a small bulb fitted practically air-tight at the bottom and closed on top by a valved tap through which the upper carbon fed. This appurtenance could be attached to any arc lamp. The negative electrode was in this case made of carbon. A circuit of lamps of this type was tested in the Winter of 1893 and early part of 1894 at Buffalo, N. Y. The report and discussion of the tests were published in the electrical journals of the time; also in the transactions of the National Electric Light Association Convention at Washington, D. C., 1894.

FIG. 1.—VENTILATED ENCLOSED ARC.

* Paper read Jan. 20, 1897, before the Société Internationale des Electriciens, Paris, France.

We come now to the ventilated enclosed arc which was devised by me a few years ago and described in some of your technical journals. You will note from the cut presented herewith that the enclosure is provided with means for directing the path of the ingress of air and the egress of gas. You observe that the bulb is pressed tightly against a practically air-tight bottom and is closed at the upper end by a bell-shaped cap or plug wherein resides the novelty of the equipment. This plug is made of metal and is shaded so that the rim is brought closely adjacent to the exterior wall of the envelope, thus providing a narrow annular passage for the outside air into the envelope by means of which the entering air is highly heated in transit before reaching the interior of the bulb. You will also see that the tubular opening through which the upper carbon feeds is conical in shape, the opening at the top being only a little greater than the diameter of the electrode, so as to permit a free feed of the latter and afford an obstructed egress for the gases from the envelope. As the closure touches the glass only at four points, shown in the drawing, the tendency of this arrangement is for all egress to take place by way of the central tubular opening, and of ingress by way of the bell-shaped chamber. In other words, the convection currents naturally formed by the heat of the arc are taken advantage of to secure a steady and uniform circulation of oxygen-bearing gas in the enclosure. By the use of this equipment the life of the electrodes was prolonged three or four times, the lamps being operated on a constant-current circuit under practically the same conditions as to current and voltage as the open arcs. In practice it was found that the ventilated enclosed arc had many shortcomings and could rarely be operated under favorable conditions on commercial circuits.

The next step in the development of the enclosed arc light gave us the method and devices which are in successful use at the present time. Before taking up this branch of the subject I shall submit to you a short report of life tests and experimental investigations made with the old equipment which I have already shown you. The length of cylinder used was 16.5 centimetres over all, the diameter of body 7.66 centimetres and the capacity 0.625 litre. The memoranda on effect of introducing various ingredients into the carbons and on the influence of different gases on the arc are digested from elaborate notes and observations, and are given rather with the idea of recording the general results than analyzing the details of each experiment. I shall also refer to other phenomena observed in using this cylinder, especially that known as "building" of the negative electrode.

I.—TABLE OF LIFE TESTS; CYLINDER WITH VALVED CAP; CARBONS 11.11 MILLIMETRES IN DIAMETER.

Diameter of hole in valved cap. (In millimetres.)	Mean current. (Amperes.)	Mean arc tension. (Volts.)	Mean energy. (Watts.)	Consum'tion (+) carbon per hour. (In millimetres.)	Consum'tion (—) carbon per hour. (In millimetres.)
11.15	7.97	63.11	503.49	2.222	0.102
11.905	7.96	62.9	500.68	1.988	0.312
12.7	7.99	62 96	502.21	1.905	0.424
14 287	7.99	62 8	501.77	2.328	0.424
17 46	8 00	61.1	496.80	2.763	0.534
23.575	7.94	62.8	498 69	11.556	8.077

Life tests; Cylinder with Valved Cap.—In Table I the comparative measurements are recorded showing the life of the upper and lower carbons respectively for different-sized openings in the metallic cap or plug. It will be noted that in the first test the diameter of the opening in the plug is only a shade greater than that of the upper carbon; in next to the last test the diameter is 6.35 milimetres larger than that of the carbon, while in the last test the plug is removed from the cylinder. As is very natural, the life decreases rapidly as the opening is enlarged, but as shown in the tests does not necessarily vary directly with the size of the opening. In each of the tests recorded the arc was started at a point slightly higher than the centre of the bulb. It will also be seen that the life of the negative decreases much more rapidly than that of the positive, as the ingress of oxygen into the enclosure is increased. Thus when the positive carbon fitted tightly in the opening of the plug

$$\frac{\text{life } (+)}{\text{life } (-)} = \frac{2.222}{0.102} = 21.78.$$

When the diameter of the opening in the plug was 6.35 millimetres larger than that of the carbon, the excess of oxygen due to enlarged opening attacked the negative vastly more than the positive, resulting in

$$\frac{\text{life } (+)}{\text{life } (-)} = \frac{2.753}{0.534} = 5.16.$$

II.—TABLE OF LIFE TESTS; CYLINDER WITH VALVED CAP; CARBONS 11 11 MILLIMETRES IN DIAMETER; MEAN CURRENT, SIX AMPERES; MEAN ARC TENSION, 63 VOLTS.

Position of arc in cylinder.	Mean length (—) carbon. (In millimetres.)	Consumption of (+) carbon per hour. (In millimetres.)	Consumption of (—) carbon per hour. (In millimetres.)
Near top.....	158.75	2.362	0.266
Between centre and top.....	140.97	2.921	0.266
At centre.....	123.19	3.683	0.393
Between centre and bottom.....	95.25	3.073	0.660
Near bottom.....	66.12	4.825	0.965

When the plug was omitted the disparity became still greater and

$$\frac{\text{life } (+)}{\text{life } (-)} = \frac{11.556}{8.077} = 1.43.$$

In Table II. I give the results of life tests in which the position of the arc was shifted from the extreme upper part to the extreme bottom of the cylinder. It will be noted that in the first test the negative was 158.75 millimetres long, while in the last it was only 66.116 millimetres long. As the arc shifts in position from the top toward the bottom of the cylinder the life of the carbon decreases. This is due to strengthening of the convection currents as the negative burns away, and consequent increase in admission of oxygen.

Influence of the Surrounding Atmosphere and of the Constituency of the Electrodes.—First, hydrogen; introduced through a hole in the positive carbon; tests made through range of 6 to 11 amperes and 60 to 77 volts at the arc, voltage of the mains being practically constant and equal to 120. There was only a slight variation in the length of the arc throughout this range, the maximum length being 2.36 millimetres and the minimum 1.65 millimetres. Thus it will be seen that the presence of hydrogen tends to increase the resistance of the arc greatly, thereby shortening it to about one sixth its normal length in carbon gas for the same current and voltage. The arc is also unsteady, and the light cut down to a large extent. It may be noted here that when moisture has settled in the bulb or carbons of an ordinary enclosed arc there is a tendency toward reproduction of the above conditions, the arc in such a case being very short and unsteady at start and remaining so until the moisture has been dissipated.

Second, iodine; tincture of iodine placed in a small glass immersed in sand in bottom of cylinder. Current ranged from 5.5 to 8 amperes in different tests; voltage of arc from 70 to 75; voltage of mains 120; minimum length of arc 2.79 millimetres, maximum, 3.17 millimetres. It will be noted that the action of iodine is somewhat similar to that of hydrogen, the tendency being to increase the resistance of the arc and thereby shorten the latter; the effect however is not as marked as in the last case.

Third, chlorine; generated in the general way and admitted to the cylinder from the bottom through a tube. Current ranged from 2.3 amperes to 8 amperes; voltage of the arc from 80 to 96 volts; length of arc from 6.35 millimetres to 36.32 millimetres. It will be noted that in this case the results are entirely different than in the other two. The presence of chlorine reduced the resistance of the arc greatly, so that at 2.4 amperes and 80 volts the length was 6.35 millimetres, while at 8 amperes and 96 volts the length was over 36 millimetres.

Following are some of the results with impregnated carbons:

First, sodium carbonate ($NaCO_3$); carbons which had been soaked over night in a solution of $NaCO_3$, gave a steady arc for two hours at 8.5 amperes and 55 volts, after which for the same length of arc the voltage increased appreciably until the effect of the solution disappeared entirely. The deposit on inner wall of cylinder after two hours was thick and had a tendency to crack the glass. The ordinary foreign and American cored carbons have sodium carbonate in their cores and give similar results to the above, though less marked.

Second, ammonium chloride (NH_4Cl); when carbons were saturated with NH_4Cl the arc was over twice as long at same voltage as in last case. NH_4Cl evaporated at a comparatively low temperature, but decreases the resistance of the arc and leaves practically no deposit in the bulb. The lower part of the cylinder became coated with

condensed vapor shortly after the arc was started, but as soon as the heat became intense enough this formation was dissipated, and the glass became perfectly clear. At the end of a four-hours' run the extreme lower end of the cylinder was slightly coated with a yellowish-green band.

Third, magnesium oxide (MgO); $MgCO_3$ when used as a core of the negative carbon is converted by heat to MgO, CO_2 gas being driven off. The CO_2 is dissociated at a comparatively low temperature, and, as may be expected, the voltage necessary for a steady arc is quite low. For 15 minutes the P. D. of the arc ranged from 40 to 45 volts with a current of eight amperes, the arc meanwhile being quite steady; the area of the crater was about eight square millimetres. The decomposition of the $MgCO_3$ was marked by a series of slight and almost inaudible explosions; finally a hard bead of MgO was left at the tip of the negative. This bead was extremely refractory; it did not succumb to the heat of the arc, but persisted

Fig. 2.—Result of Enclosing the Arc Air Tight.

as an incandescent globule from which the arc stream seemed to issue. The P. D. of the arc varied from 44 to 50 volts at 8.5 amperes, the arc being quite steady for almost an hour; there was no appreciable coating on the internal surface of the cylinder. Occasionally a slight greenish hue was noticeable in the arc.

For comparative purposes different types of carbon points, all practically alike as to purity, but varying in granular structure, were tried. The following combinations were tested: First, lamp-black molded; second, lamp-black squirted; third, gas-black molded, fourth, gas-black squirted; fifth, petroleum coke molded; sixth, petroleum coke squirted. The results were practically the same for all structures of carbon.

The tabulated data show that for the same current and length of arc the P. D. at the carbon points will depend upon the surrounding atmosphere as well as on the constituency of the electrodes. The fall of potential from one carbon to the other follows, in general, the well known law, the major portion of the drop (for short steady arc) being from the positive carbon to the arc stream. There was one experiment, however, which gave very surprising results, and which is deemed worthy of mention in this connection as the phenomena observed seemed to constitute an exception to the rule. A steel nail was driven into a hollow negative carbon as a substitute for the core. The sharp end of the nail projected just above the tip of the carbon. A solid positive carbon was used. When current was passed there were brilliant scintillations due to incandescent steel, followed by fumes which coated the internal wall of the chamber with a dark reddish deposit of FeO. A molten steel ball soon formed in the concavity at the top of the negative. The length of the arc was between 3 and 4 millimetres, current being from 8 to 9 amperes and the P. D. at the arc varying from 20 to 30 volts. The negative was intensely hot, while the positive was comparatively cool. The area of the crater in the positive was about one square millimetre, or about one-eighth of that in the other cases. The arc, expanded in cross-section at the negative and tapering at the positive, darted from point to point across the projecting surface of the upper carbon, sometimes jumping a distance of five to six millimetres to select a path; meanwhile the negative glowed with constant brilliancy. The arc always played from the side of the molten steel ball, the latter often spinning like a top, seemingly in unison with the arc. The results of this experiment seemed to indicate an accidental reversal of current, but subsequent tests showed that no such reversal occurred.

Blackening of the Internal Surface of Enclosure.—Before taking up the analysis of the latest development of the art let us pause for a few moments and examine into the underlying principles governing the successful operation of enclosed arcs of to-day. Let us start out with the operation of an enclosed arc within an air-tight compartment to which the outside atmosphere has absolutely no means of communication. The photograph I give herewith represents such a structure and illustrates the results which follow the passage of current. I shall show you the stereopticon view of the apparatus on the screen later on. You will note that the glass which was originally cylindrical, now has a large spherical protuberance at the side. You will also note that the chamber is coated on the inside with a heavy black deposit. This apparatus was originally air-tight and the carbons in contact. Current was passed so as to form an arc, and in due time the length of this arc increased from 0 to about 9 millimetres, as the carbons consumed. The bulb began to blacken after the oxygen contained in it went into chemical combination with the carbon vapor of the arc stream. Such a result is natural, as the disintegration of carbon must go on as long as the arc plays; the carbon having no substance with which to combine is thrown off in the form of a black soot on the internal wall of the chamber. Moreover, as in this case, when there are no means of exit for the expanded gases, the pressure is sometimes sufficient to distend and rupture the envelope.

Although the blackening of the internal wall of the chamber always follows the operation of a carbon arc in an air-tight enclosure, the same discoloration may occur under other circumstances when the enclosure is not air-tight or even nearly so. This second case is illustrated in a cylinder in which the annular space around the entering carbon permitted of access of oxygen to the enclosure. The blackening was due to a large current and a short arc. In the photograph I have placed a clear cylinder alongside of the other for

Fig. 3.—Blacking at Low Voltage of Arc.

comparative purposes. You will note that the deposit is inky in color and quite uniformly distributed over the surface of the glass. In this case the carbons were burned for three hours at a current of 18 amperes, the arc tension being 30 volts. The amount of impurity in the carbons was inappreciable.

(*To be continued.*)

Protective Devices for Transformers.*

BY HERBERT C. WIRT.

The transformer itself is a protective device, as it was introduced to permit the operation of incandescent lamps from high-voltage circuits, with safety to human life. It has so well accomplished this purpose that there are in operation in the United States 4,000,000 16-cp lamps, which are supplied with energy by means of transformers.

A large number of transformers were introduced 10 years ago, at a time when experience with electrical machinery for operation on high-voltage circuits was limited, and therefore many transformers were not properly constructed, and the failure of the insulation may be laid in part to faulty design.

The object of this paper is to call attention to several protective devices which have been designed to render the transformer absolutely safe, and to suggest some precautionary measures that should be used by managers of central stations.

The cases which have occurred where the primary current has passed to the secondary wiring are comparatively few, but still sufficiently numerous to warrant the taking of greater precaution to prevent the possibility of fatal accidents.

This subject is receiving careful attention on the part of the underwriters, and many central station managers are looking into the question. Very little information has been published on this subject. Mr. William H. Merrill, Jr., electrician of the National Board of Fire Underwriters, has issued very valuable and interesting reports relating to fires of electrical origin, and during the past three years 62 cases have been mentioned by him where the primary current has passed to the secondary wiring, and which have been considered only as a fire hazard.

The following cases have been investigated and may be of general interest:

"Fire No. 867. Converter burn-out. About 60 converters connected by serial wires burned out by lightning."

Investigation showed that these burn-outs occurred in transformers not insulated with oil. The primary voltage was 2750. The line was not protected by line arresters, but was protected by station arresters. The secondary wires were run in a damp building and were quite likely grounded, thus affording an easy path for the primary current to reach ground through secondary wiring, and across the insulation in the transformer.

"Fire No. 1000. Converter burn-out. Primary current on secondary circuit. Current grounded through soft rubber insulating joints on combination fixtures. Rubber burned out and escaping gas ignited. Discovery prompt; electricity and gas turned off, preventing serious damage."

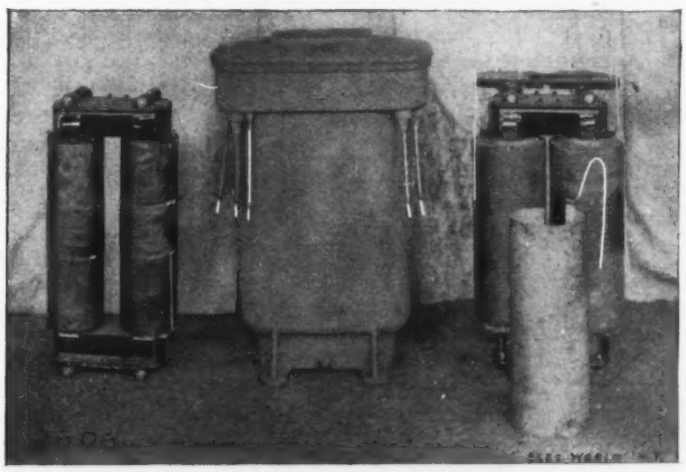


FIG. 1.—GROUND SHIELD OF TRANSFORMERS.

These burn-outs occurred in transformers not insulated with oil, and which were connected to a 1000-volt circuit. Lightning arresters were installed at station and on lines. These burn-outs did not occur during a storm.

"Fire No. 1370. Converter burn-out. Primary current on secondary circuit. High-tension current grounded through secondary wiring to a gas pipe placed near a single-pole switch. Gas pipe was scarred by the arc, the switch and connecting wires were fused and the interior decorations at the point were damaged. Loss about $300."

Transformer was connected to a 2000-volt circuit, was run without oil and was not protected by line or station lightning arresters. The burn-out occurred during a lightning storm. There was no evidence of a leak between primary and secondary previous to the storm. The transformer was of modern type and was first used May 17, 1895.

"Fire No. 1445. Converter burn-out. Primary current on secondary circuit. Current grounded through rubber insulating joints of fixtures

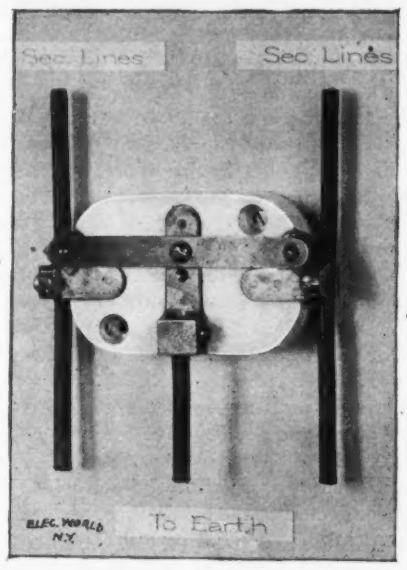


FIG. 2.—THOMSON PROTECTIVE DEVICE FOR TRANSFORMERS.

burning out rubber, allowing gas to escape and ignited the gas. Part of the side wall and ceiling of the dwelling burned, together with partial destruction of carpet and some fixtures. Prompt discovery of the fire by a patrolman passing the building, who prevented serious loss, as the occupants were away at the time. Loss, $150."

This burn-out occurred during a lightning storm. Arresters were installed at station and on lines. In this transformer, which was manufactured in 1888, oil was not used. Primary voltage 1000.

"Fire No. 1446. Converter burn-out. Similar to No. 1445. Part of ceiling and joists of dwelling house burned. The occupants managed to shut off the gas at the meter immediately the fire was discovered. The case of this transformer had originally been grounded but the ground wire had been cut subsequently. Loss $50.

Transformer was connected to 1000-volt primary; was protected with arresters, and no oil was used.

You will note in every case the electrical discharge ignited the gas. It is easy to see the cause of this. The current passes from the secondary wires to the fixture, and then across the insulating joint to the gas pipe system and to earth, forming an arc at the insulated

FIG. 3.—CARDEW EARTHING DEVICE.

joint, thus igniting the gas. If, however, insulated joints were not used, the path to earth from the secondary wires would be made easier, and probably a greater number of breakdowns would occur.

Note that all these accidents occurred in transformers that were not insulated with oil. Note also that many of these breakdowns occurred during a lightning storm, proving conclusively that most transformers are burned out, not by the alternator current, but by electrical discharges, due to the disturbances of the atmosphere. It

* Extract of a paper read before the Milwaukee meeting of the Northwestern Electrical Association.

is therefore necessary to have a transformer insulated to stand such discharges, rather than to stand the alternator potential.

In the early days of transformer construction the insulation was not designed to stand any definite voltage in excess of the alternator voltage. A transformer was supposed to be properly made if it did not burn out when tested on the standard current for which it was designed. Transformers of early design will just stand a high potential test of 3000 volts.

The majority of transformers manufactured during the past year are made to stand a test of 5000 volts between primary and secondary windings. One manufacturer has brought up the standard of insulation to withstand 10,000 volts alternating potential between primary and secondary.

The insulation of transformers should always be measured with high potentials, rather than by an insulation resistance test, in which a moderate voltage is used. Five hundred volts are not sufficient to properly test transformers, for it is easily seen that a small gap or break in insulation may be great enough not to be bridged by a potential difference of 500 volts, but the normal alternator potential of 1000 or 2000 volts will immediately start an arc across the defective insulation.

Oil should always be used to insulate transformer windings, as high potentials will jump a space in air five times as great as in oil. The oil keeps the air from the coils, and prevents oxidation of the insulation material. The air in a transformer not insulated with oil is heated and expanded from the coils, and when the transformer is cooled air containing moisture can be drawn into the coils.

A number of automatic devices have been designed to be connected to the secondary wiring of transformers, so that in event of the high-tension primary-current passing to the secondary wiring, it will be automatically connected to the earth, thus preventing any danger of a shock, or the possibility of causing a fire.

The most prominent devices are those designed by Prof. Elihu Thomson in this country and by Major Cardew, electrical advisor of the Board of Trade in England.

The Cardew earthing device consists of two metal plates, separated and insulated from each other by ¼ inch air space. The plates are held in a horizontal position. A thin strip of aluminum foil, about 3 inches long and ¼ inch wide, is flexibly attached at one end to the upper plate, which is connected to the secondary wiring and the other end is supported near to but normally not in contact with the lower plate, which is connected to a good ground. If a difference of potential of about 300 volts exists between these two plates the aluminum foil is attracted to the lower plate and will remain in contact with it until the primary fuses are blown. This therefore automatically grounds the secondary whenever there is a difference of 300 volts potential between secondary wires and earth.

Several thousand of these devices are in use in England, as such apparatus is required by the following regulation of the English Board of Trade:

"In every case where a high pressure supply is transformed for the purpose of supply to one or more consumers, some suitable automatic and quick acting means shall be provided to protect the consumer's wires from any accidental contact with or leakage from the high pressure system, either within or without the transforming apparatus."

On the three-wire system, the device is connected to the neutral wire. With small transformers it is connected to only one side of the secondary circuit, and with large transformers one is placed on each secondary wire.

It should be mentioned that most of the primary wires are run underground in England, and the transformers are not, therefore, subjected to atmospheric discharges of electricity.

Prof. Elihu Thomson has invented several protective devices. The film cut-out, so called, is quite similar in its action to the Cardew earthing device, the only difference between the two being that the plates are separated by a thin film of paper, which is pierced by a potential of 300 volts, making a good connection, and thus permitting the primary fuse to melt. The device was first commercially used in 1890. The transformers at that date were so poorly insulated that it was found that the primary current passed to the secondary wiring so frequently that their use had to be abandoned.

Prof. Thomson's most prominent protective devices, developed in 1885, are known as the ground shield and grounded secondary. The ground shield consists of a sheet metal covering, placed in the transformer between the primary and secondary windings, in such a way that it is impossible for any current to pass from the primary to the secondary windings without connecting with the metal shield. The shield is connected to a good ground, and therefore the primary current will not pass to the secondary wiring.

Transformers fitted with ground shields are quite generally used in England, as these transformers meet the specifications of the Board of Trade.

In the grounded secondary system, the house wiring is permanently connected to ground. This connection may be made from either side of the secondary, or carried from the middle point of the secondary winding in the transformer. In the latter case, there is a difference of half the potential of the secondary system existing between the secondary wires and the earth. If only one of the secondary wires is grounded, there exists a difference of potential between the earth and the other secondary wire equal to the full secondary voltage.

These systems, therefore, are objectionable from an insurance standpoint, as it has not been thought desirable to have the secondary system grounded, on account of the danger of leakage of the secondary current.

The film cut-out and Cardew earthing device have an advantage over permanently grounding the secondary, as there is less liability of a leak from wires to ground, except at the time when the devices are short-circuited.

A large installation in the town of Suncook, N. H., has been in operation during the past year, with a grounded secondary. The installation consists of 2000 lights, located in several mills, and about 500 in the town. The generating station is located six miles from the town and mills; primary 2500 volts. A three-wire secondary system is used, 100 volts on each side. The neutral wire is grounded. The lines are well protected by lightning arresters, which were not of the short-gap type.

Two transformers have burned out, but after a careful examination, the conclusion was arrived at that one of the transformers at least had been injured by water, as the transformer-box had been opened during a heavy rainstorm. If the short-gap lightning arresters were used, there would be less liability of the transformers burning out.

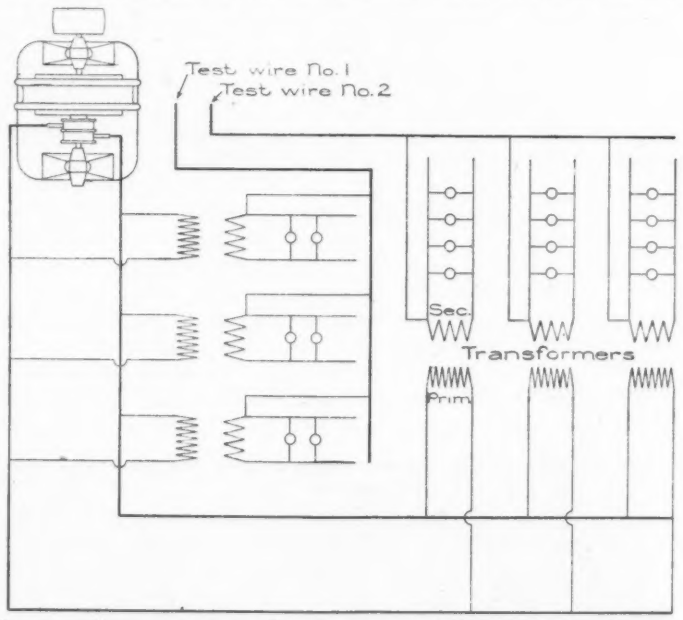


Fig. 4.—Connections of Transformer Test-wires from Central Station.

It will be seen from the above that the lightning arrester is a very important protective device, as we must depend upon arresters to conduct the lightning discharges to the ground. If we did not use arresters, it would be almost impossible to construct a transformer that would not burn out. We might use a protective device to prevent any danger from the current passing to the secondary wiring, but we would frequently have transformers burn out.

Arresters have heretofore been designed solely for the purpose of preventing the dynamo current maintaining an arc after the passage of the lightning discharge. A new arrester has been designed which affords an easy path to ground for the lightning current.

A careful test of the various arresters on the market to-day shows that the 1000-volt arresters require from 3000 to 4500 volts, and the 2000-volt arresters require from 6000 to 9000 volts potential to cause the current to pass from line to ground across the gaps.

As the insulation of the transformers can best be tested by a high potential current, so also arresters should be tested by the same high potential current, and they should be constructed so the current will pass across the gaps in preference to passing through the insulation of the transformer.

The necessity of a short gap arrester has undoubtedly been known to many experimenters, but until recently no method was devised to permit the short gap arresters to be used on high-voltage alternating currents. An arrester has recently been designed so that but one gap of $\frac{1}{32}$ inch is required for a 1000-volt arrester, and two gaps of $\frac{1}{32}$ inch each for a 2000-volt arrester, requiring 2000 and 4000 volts respectively for the current to pass across the gaps.

It is believed that these arresters will afford protection to transformers provided with insulation that will stand a 5000-volt potential test.

This arrester consists of large metal cylinders, separated by short air gaps, in series with which is placed a low non-inductive resistance to limit the current at short circuit. The arc is cooled so that upon the reversal of the alternating machine current it is extinguished.

Transformers having defective insulation between primary and secondary should be immediately disconnected. The only way to discover a transformer of this kind is to make insulation tests, and therefore it is apparent that periodical tests should be made of the insulation between primary and secondary of all transformers.

As a high potential is necessary, a small step-up transformer should be used, which can be carried around to the points where the transformers are located. This transformer should have a capacity of at least two kilowatts for testing transformers of 30 kilowatts capacity and less, in order to supply the capacity current.

In making a test, the house transformer is disconnected from both the primary and secondary wires. The primary of the test transformer is connected to primary lines, which are energized by the alternator. The secondary is connected to the house transformer; one side to primary, and the other to secondary. A rheostat, or reactive coil, is located in series with the primary of the test transformer, so that the secondary voltage may be varied between the limits of 2500 to 10,000 volts. A fuse should be located in the primary circuit, to open when the insulation is punctured.

The high potential should be applied for 60 seconds, and any transformer that will not stand a 3000-volt test should be scrapped. It will be found that the transformers that have poor insulation also have very high core losses, and are not economical, for in many cases it will be found that the revenue obtained from the transformer will not be sufficient to pay for the coal used in generating the current to supply the iron core loss. Therefore, it will be most economical to scrap such transformers.

This test should be made as frequently as possible, and at least once a year. When making it, the secondary should be connected with the iron core, as this acts as a condenser and a high potential current would be generated in secondary wires, which would burn out the insulation between secondary wires and core.

Transformers are not generally tested for leakage between primaries and secondaries, and as they are isolated on the line, there is no means of testing for leakage at the central station without extra wires. It is apparent that is necessary to make frequent tests of this kind. An interesting method of testing transformers has been in operation at Great Falls, Montana, for the past two years. The secondaries of half-a-dozen transformers are connected to a common test wire, which is run to the central station, and tests are frequently made there between this test wire and each side of the primary circuit. The normal primary current of 2080 volts is used for testing.

A fatal accident, and several cases occurred where persons had received severe shocks, and for this reason the electrical engineer in charge was most anxious to keep his transformers in good condition. A test made on transformers on the line disclosed the fact that three or four of the transformers had primary and secondary coils in contact. All these transformers were not insulated with oil. Since using the test wire the system has been operated without accident, and a great saving of time has been effected by means of the test wire. It would seem that there might be many cases where this system would be of advantage.

A fatal accident can only occur when the following connections are made:

First: A ground on one of the primary wires.

Second: A leak between primary and secondary on the opposite side of the system on which the ground is located.

Third: A person in circuit with the secondary and ground. As the majority of lamps are installed in locations where it is imposible to get a connection to ground, many chances of receiving fatal shocks are avoided. If the primary lines are kept free from grounds, no shock can be obtained. It is therefore essential to use the most approved appliances at central stations for indicating grounds on primary wires.

The most common ground detector in use at present consists of a transformer, the primary of which is attached to the line to be tested and the ground. The secondary winding of the transformers is in circuit with an incandescent lamp. The ground is indicated by the brilliancy of the lamp. This seems to be a very crude method of indicating grounds, as there is an opportunity of error, and the detector is connected only at stated periods. It has been said that alternating lines always have a slight ground, as the ground lamp always burns at a dull red, This is due to the capacity effect of the lines, and not to actual leakage of primary current.

The transformer system can be greatly improved in the following manner:

First, there should be used at the station and on outside lines short-gap lightning arresters that will permit the passage of the current across the gaps, before the insulation of the transformers will be broken down.

Second, transformers operated on 3000-volt circuits or less, should be constructed to stand a high potential test of 7500 to 10,000 volts for 60 seconds between primary and secondary windings.

Third, a safety device should be used in connection with transformers, that will prevent any difference of pressure in excess of 300 volts between secondary wires and ground.

Fourth, transformers should be filled with oil.

Fifth, transformers should be periodically tested for insulation between primary and secondary, with high differences of potential.

Sixth, a ground detector which will positively indicate a leakage of current from primary wires to ground should be used at the central station. It should not be affected by the capacity effect of lines, and it should be designed to be left permanently in circuit.

Independent Telephone Interests in Indiana.

A meeting of representatives of independent telephone interests in Indiana was held at Fort Wayne, on Jan. 19, under the auspices of the Home Telephone Company, of that city. There was a large attendance, and the meeting was called to order by President G. W. Beers, of the Home Telephone Company. Mr. E. H. Andress, president of the Lafayette-Harrison Telephone Company, was chosen presiding officer, and Mr. W. H. Ernst, president of the United Telephone Companies, of Bluffton, secretary.

Judge James M. Thomas, president of the Ohio Telephone Exchange Association, Chillicothe, O., made an address in which he reviewed the benefits that would follow a compact and comprehensive union of the independent telephone exchanges of Indiana in an association similar to the Ohio association, of which he is president. The mutual benefits, he said, would be incalculable and while the exchanges would preserve fully the independent character which they now possess, they would be as one in all things affecting their common interests.

He was followed by Judge R. S. Taylor, who spoke on the subject of the Berliner patent suits that have been pending in the Federal courts since 1893 and in which the United States Supreme Court is expected to render a final decision at no very distant day. As the decision in the Berliner cases will determine whether the Bell Telephone Company will have a monopoly for more than 10 years longer or not, Judge Taylor's subject was of unusual interest to all the telephone men present. Judge Taylor, is chief counsel in the suit brought by the United States Government to annul the Berliner patents.

After a discussion on questions of general interest, Mr. C. S. King, of Wabash, offered the following resolution, which was adopted:

RESOLVED, That it is the sense of this meeting that the local telephone companies of the State of Indiana take such action as may be necessary to petition the General Assembly of the State of Indiana to enact such legislation as may protect local telephone companies either in a general anti-trust statute or a statute defining a monopoly, or other legislation for the benefit of independent telephone companies.

After the adoption of this resolution, Mr. King suggested the propriety of employing Judge Taylor or ex-President Harrison to draw such a bill for presentation to the Legislature.

The legislation necessary for the protection of the independent companies was fully considered and as a result a legislative committee of nine was appointed to watch the interests of the local telephone companies in Indiana.

CONVENTION OF THE NORTHWESTERN ELECTRICAL ASSOCIATION

MILWAUKEE, WIS. JAN. 20 & 21, 1897.

The fifth annual convention of the Northwestern Electrical Association was held at the club house of the Pfister Hotel, Milwaukee, Wis., on Jan. 20 and 21.

FIRST DAY'S PROCEEDINGS.

The convention was called to order at 11.40 a. m. on Wednesday, by H. C. Higgins, second vice-president.

The report of Secretary Mercien was read and accepted, after Mr. Mercien had been complimented upon the report, and also upon the excellent work he had done on behalf of the association.

Thirty new members were unanimously elected.

Several communications were read, including three inviting the association to hold its next meeting at Marquette.

After some routine business had been disposed of Mr. F. S. Terry, of the Sunbeam Lamp Company, Chicago, read a paper on "Incandescent Lamps." This paper will appear in the next issue.

At the conclusion of the reading of the paper a vote of thanks was extended to Mr. Terry.

Adjournment was then taken until 2 p. m.

The afternoon session was called to order at 3.50 o'clock.

Mr. H. C. Wirt, of Schenectady, N. Y., read a paper on the subject of "Protective Devices for Transformers," to be found in abstract in other columns of this issue.

In the discussion which followed Mr. F. McMaster asked how the grounding core is arranged so that there are no losses from induction in the protective device.

Mr. Wirt stated that the shield is a sheet of copper and the ends are insulated so that there is no current passing in the shield. If a complete loop around the core is made of course there would be current wasted in the shield.

Mr. S. Pierce inquired what kind of a device the author recommends to have permanently left in the circuit, in order to show the ground which could be used there, that would not cause trouble in some other way.

Mr. Wirt replied that a static instrument can be used, something like Sir William Thomson's static voltmeter. Each line will form a coil and the capacity effects of line will balance, and if there is a leak the difference will be measured by an indicator.

Prof. W. M. Stine asked if there is any scientific connection between the high-core loss and the low insulation in the second wire. Is one the consequence of the other, if you continue the excessive heating?

Mr. Wirt: There is no scientific connection between the two. I merely wanted to make it as easy as possible for the gentlemen to take off their old transformers. (Laughter and applause.)

Mr. W. W. Bean: If Mr. Wirt wants to make it as easy as possible for the gentlemen present to take off their old transformers, I hope the chair will not let this argument close until every electrical engineer is heard from, because we want to know something about the transformers before we buy them.

Mr. Wirt: I might say that in the case of a transformer supplying my house, which has been in operation 16 months, being interested in the subject, I wanted to find out how much money the central station had made. I took the bills for 16 months down and measured the core losses and found that the central station had made just enough money to pay for fuel for core losses to say nothing of the energy lost in supplying the lights; so that you see is a very important subject to look into.

The thanks of the association were then tendered Mr. Wirt for his very interesting paper.

A paper on the subject of "Insurance as Affected by Electrical Construction" was then read by Mr. George S. McLaren of Milwaukee, and will be found elsewhere in this issue.

In the discussion Mr. McLaren stated, in reply to questions, that a correctly installed electric light equipment is considered a far better risk in every way than a kerosene-lamp outfit. If a building has had its premium rate increased on account of the use of kerosene lamps, and then they are removed and a correctly installed electric light plant put in, the premium rate will be correspondingly reduced. As regards gas no increased rate is added for the common use of gas. A first-class electric light installation is the safest there is. There is no real difference in the rate. It is impossible to charge for very small differences. He further stated that they do not consider the use of water-proof wire inside of buildings at all. Rubber covered wire, with good braid, is the only satisfactory insulation. We would not allow water-proof wire inside of buildings under any circumstances. Moisture will so reduce the insulation in water-proof wire that after a while it becomes almost useless.

The subjects of electrical wiring and of requiring electrical construction men pass an examination such as is required of plumbers gave rise to a lengthy discussion, and beyond the mere expressions of views on the same no definite results were attained.

Mr. Doherty, chairman of the Special Committee on Municipal Ownership, then read the report of that committee.

In the report it is stated that the committee was instructed to confer with the electrical manufacturers and obtain their promise of co-operation in preventing the misrepresentation as to cost of installation. operation and results obtained from municipal plants. The large manufacturers, although claiming to co-operate with the committee, have, in spite of their statement to that effect, failed to do so. The committee then states: "We therefore think the best evidence of good faith they can furnish the central station men of the country is to let this branch of the business alone. We therefore suggest that the committee carrying on this work be instructed to report at each meeting the number and locations of municipal plants installed, and the names of the manufacturers furnishing the steam and electrical apparatus. All advocates of municipal ownership must be regarded as the natural foes of central station men and others who desire the welfare of the business as a whole.

"We have endeavored to investigate the results obtained in the municipal plants already established, but find that this cannot be properly done except by sending a capable representative to these municipal plants. We have written for regular city reports, and have sent out blanks requesting answers to a number of questions asked. We find that in the majority of instances, the expense report as covering the cost of electric lighting does not cover such cost, as is evidenced by finding electric light expenses charged under separate heads, and in but few instances does the city figure anything against the plant for interest, depreciation, taxes, water rent, office rent, management, fire insurance, employers' liability insurance and general risk. It is needless to say that without including but a portion of the expense of conducting an electric light plant they can send out reports that look very inviting to other cities who are paying a fair rate for lighting their streets and houses. The easiest way to demonstrate the fallacy of this scheme is by making a personal investigation and determining just what portion of the expenses are omitted that should be figured against the cost of the city's expenses in operating their electric light plant.

"As no appropriation was made to cover the expenses of this committee, it was impossible for us to do all that might have been done to demonstrate the falsity of the reports sent out by the various cities operating their own plants. We, however, have gathered considerable information that will undoubtedly prove of interest to central station managers threatened with this form of opposition. We would recommend that a liberal appropriation be made to cover the expenses of the work to be done by your committee for the coming year.

"In regard to the information gathered, we consider it advisable to hold this as confidential for the use of our members and such central station men who are threatened with this form of opposition. By making the facts public nothing can be gained, and it allows the advocates of municipal ownership to avoid quoting the plant that they know we have evidence with which to disprove their assertions. We also think it best not to disclose our manner of obtaining information on the failure of municipal plants as this would give our competitors an equal footing, provided they

have not already availed themselves of the same avenue of information."

Mr. Elihu Colman then continued with an additional report. He stated that if the municipal lighting movement is right, we gain nothing by kicking, but will be injured by reaction.

"If that movement is without proper foundation it must be met by facts and figures. Probably the majority of electric plants to-day were installed on a fictitious basis, with the capital stock much above the actual investment and bonds issued to a vastly larger amount than the real investments.

"Representations of values did not materialize, confidence in these investments was lost, and even clean, honest securities could not be placed and are still at heavy discount.

"This was the electric era of *promoters*, and was quickly followed by the era of assignments, foreclosures and receivers.

"The former fraudulent transactions have been shown up, the impression being left on the public mind that electric light can be produced at a much less figure than is paid for it.

"We who are in the business know how far they are out of the way.

"Water works corporations and lighting corporations are from their very nature quasi-public corporations.

"They cannot operate without a franchise from the municipality. That franchise when accepted becomes a contract between the city and the corporation, and carries with it obligations binding both.

"The city signs it for two reasons. First, that private parties shall put in the capital and produce the electric current to light the streets and public buildings, and second, to light the houses and business places of the citizens.

"If the company does its work well and in good faith, it has a right to expect good faith from the municipality.

"The company pays its taxes, furnishes good light, and is a boom ing card for citizens to boast of.

"Is it equitable on the part of the city to enter the field against such a company and as a competitor to it, merely because with its help the city treasury has become plethoric and it can build its own plant?

"On the other hand, if the company after receiving its franchise has only played the role of a leech, then the city fathers should cause its franchise to be judicially annulled and proceed to build its own plant, or to do what is better, contract with a reliable company to furnish the city and its citizens with equitable but living rates.

"Your committee does not give an opinion that the municipality either has or has not a legal right to thus destroy the value of the local plant. That question must be settled by the terms of the franchise itself.

"All will agree that it has neither the moral nor equitable right to do so.

"It is therefore certain that the muncipality should not be given the power to put in plants, unless—first, the existing companies shall be bought out, or second, their stock bought up, or third, if agreement of purchase cannot be made, that process of condemnation be had under power of eminent domain as in railways.

"While hardships might come to some, these methods would all be fair and equitable.

"The remaining questions are these:

"First: Is municipal ownership practical?

"Second: Will it be remunerative?

"The office of a town or city is not to dig our potatoes, cut our wood, or to do any of the ordinary work of life, excepting of course to furnish lawyers with lawsuits, but its office is to do for all its citizens such work as individuals or corporations cannot do for themselves, such as furnishing protection, building and maintaining streets and furnishing water and lights, and the two latter can better be done by the quasi-corporation in most cases than by the city itself, and these franchises are given to these corporations to relieve the city of an additional swarm of bloodsuckers, both political and personal."

Mr. Colman draws the following conclusions:

First: That legislatures should grant no powers to municipalities to erect and maintain lighting plants for general use, unless where franchises have been given the owners of the same shall have been remunerated, as herein set forth.

Second: That honorable manufacturers will not sell to municipalities until these steps have been taken, and central station men cannot afford to deal with manufacturers showing themselves thus dishonorable.

Third: That if we cannot show to municipalities that the business is unprofitable to a city, including, of course, the item of taxes, lost interest on investment, depreciation, etc., then we should be silent.

Mr. W. J. Buckley made a lengthy and able argument against municipal ownership. Municipal ownership, he said, is a fallacy, a fad, an idea that exists, and the fact as it exists must be faced. The property of the manufacturer and central-station man should be protected. He favored the association of these interests in bringing about the desired protection through the instrumentality of legislation.

Other remarks of similar strain were made, and the committee's report was adopted by unanimous agreement. It was also decided to refer the matter of the report to the directors, with power to authorize and furnish means for the committee to carry on its work on the lines it has been following so far.

The meeting then adjourned until Thursday, Jan. 21.

In the evening Mr. Caryl D. Haskins presented a paper and gave a demonstration on "Röntgen Ray Phenomena." Mr. Haskins reviewed the history of the development in this field since the announcement of the discovery by Prof. Röntgen, after which a number of lantern slides were exhibited.

SECOND DAY'S PROCEEDINGS.

The Convention was called to order on Thursday at 10.30 a. m. Mr. Pierce, of Negaunee, Wis., then addressed the meeting on the municipal electric lighting plant in that town, in which he pointed out that the town was obliged to extend its boundary limits in order to raise sufficient taxes for the support of the local government.

Mr. John Schuette then read a paper on the "Defects and Dangers of Municipal Ownership." The author pointed out that the laws of Wisconsin permitted any city in the State to build and operate its own municipal plant as far as street lighting and public buildings are concerned, and can also sell to individuals if the existing company refuses to sell out.

The election of officers for the ensuing year resulted in the unanimous selection of Mr. H. C. Higgins for president, Mr. G. L. Cole as first vice-president, Mr. John H. Harding, as second vice-president. Mr. T. R. Mercein was elected to fill the combined offices of secretary and treasurer. By an unanimous vote Messrs. Debell, Rau and Bean were elected as members of the board of directors.

A paper was then read by Prof. W. M. Stine on the subject or "Safety Devices for Electrical Circuits." An abstract of this paper will be found in another column.

In the discussion which followed, Prof. Stine said that in his experiments great stress was laid on the element of time, and said that the length of fuse must also be carefully considered. He stated that the "critical" length, that is the length beyond which no increase in carrying capacity could be detected, was for all fuses (excepting flat) eight inches.

The first business of the afternoon session was to authorize the employment of a delegate at Madison to watch all legislative measures which may be presented affecting the interests of the association.

La Crosse, Wis., was selected as the place of meeting for the next midsummer Convention.

The secretary then read Mr. N. W. Perry's paper on "Gaseous Fuel as a Means of Cheapening Electricity," which was followed by a paper on "Electrical Supplies," by W. W. Low.

Mr. Low referred to the wonderful development in the electrical supply business in the past few years. The list of articles handled in the beginning was small, the parent companies themselves controlling electrical lighting apparatus. The supply houses eventually engaged in the electric lighting supply trade, which resulted in a great reduction in the prices. He dwelt briefly upon some of the troubles and annoyances experienced in the trade, citing as an example of one of these, the case where a telegram was received by his house at 5:30 p. m. to the following effect:

"Send one barrel Packard lamps; must be shipped to-night."

The fact that these lamps are made in three standard bases, and of many voltages, the difficulty in the way of filling the order can be imagined. But after looking up the last order from the same source it was found that it was for 110-volt Edison bases; the shipment was therefore made accordingly. Next morning a telegram came—and collect—saying that the shipper should have known that 52-volt lamps were needed.

The customers of the supply houses, he said, were a bright and intelligent class of men, and the supply men themselves must be thoroughly posted in their business, so as to be able to advise and counsel their customers. In conclusion, Mr. Low said:

"Electrical supplies have been and are in a transitory state, some rapidly becoming recognized as standard, others falling in the rear.

"I predict that in a few years it will be much easier than at present for the central-station buyer to know just exactly what he wants for every purpose and what the price should be. We, all of us, have work to do in bringing about this happy condition."

Mr. George Cutter then read a paper on "Electric Heating." In the course of his remarks, Mr. Cutter said:

"In designing apparatus for electric heating and cooking it is necessary to consider all the laws of heat—its conduction, insulation, absorption and convection—as well as those of electricity. The question of latent and specific heat must be carefully weighed when designing electric heaters or cookers for special purposes. A pound of water will absorb much more heat in a rise of 100 degrees in temperature than will a pound of copper or iron. This means that the electric heating of water (except for very small quantities) is much more expensive than the electric heating of sad irons, griddles or broilers, which immediately pass the heat on to the purpose for which it is needed. Therefore, when you equip homes with complete electric cooking outfits, as you should now begin to do, it will be advisable to recommend some other means of heating water, except in small quantities. By doing this, all the cooking of a family can be done economically by granting special rates for the current, as you can well afford to do, which statement I will enlarge upon later.

"The economy of electric heating and cooking depends upon the construction of the apparatus, so that your heat is all concentrated upon the special work in hand and for the minimum of time possible to do this work. By careful attention at the hands of the central station manager your customers can learn how to use the current economically, and when this is done, the supreme convenience and comfort of this method of cooking will cause its spread to such an extent as to enable many central stations to run their machines all day. What has been said about designing the apparatus applies with equal importance to its selection. A single piece of unsatisfactory or current-wasting apparatus on your circuit, will create an impression among your customers which may mean the loss of many times any saving in its cost, by spoiling the prospects of a profitable line. The time is ripe for station managers to begin the introduc- of this work on their circuits, with the firm determination to make it an important factor of their business.

"I am unable to make suggestions as to what rate should be made for heating current, as this will vary with local conditions. The plant that has such a demand for motors and lights as to very nearly make it pay to run all day, can afford to give very favorable terms for heating current, so as to enable them to start the all-day practice. The growth in demand after the practice is once well started will soon yield good profit.

"Let me close with a few statements which seem to be timely:

"(1) Every central station manager should familiarize himself with the well-developed heating and cooking apparatus now on the market, so as to be ready to talk it to his customers.

"(2) He should arrange to show the apparatus in operation, so as to create a public interest in it.

"(3) He should study the question of rates, so as to be able to offer special inducements to a more varied use of current.

"(4) He should educate his patrons to use the current economically, for therein lies the secret of expanding the use of heating apparatus.

"(5) And last but not least, he should insist on the use of devices which are efficient and whose durability is practically vouched for by the standing of the manufacturers."

In the discussion which followed the reading of Mr. Cutter's paper, Mr. Thayer pointed out the advantages to be derived from the use of electric cooking utensils by increasing the day load. He also referred to the revenue which might be obtained by using exhaust steam for heating purposes throughout any locality. After a brief discussion on minor matters the Convention adjourned.

The Attendance.

The list of those who attended the convention includes from Chicago, which was most largely represented:

M. B. Austin, S. E. Christie, P. A. Clisdell, Geo. Cutter, Edmund Dickey, W. E. Donley, Thos. Ferris, Henry Floy, W. H. Gray; Chas. E. Gregory, Jos. M. Hill, L. D. Kittman, A. Louis Kuehmsted, T. S. Lane, Willard W. Low, D. Graeme McDougall, Harry Osburn, Julian Roe, W. H. Schott, Geo. S. Searing, A. Shillingham, Wm. M. Smith, Prof. W. M. Stine, B. E. Sunny, A. S. Terry, F. S. Terry, Geo. Langtaff Thayer, W. P. Upham, M. A. Wheaton, Geo. K. Wheeler, Geo. S. Whyte, James Wolff, J. C. Wormley.

Among others in attendance were:

E. H. Abadie, St. Louis, Mo.; W. W. Bean, St. Joseph, Mich.; Francis A. Brown, Marinette, Wis.; L. W. Burch, Madison, Wis.; F. A. Copeland, La Crosse, Wis.; J. S. Crider, Pittsburg, Pa.; Henry L. Doherty, Madison, Wis.; A. C. Garrison, St. Louis, Mo.; W. H. Grisson; G. W. Hanley, Marinette, Wis.; F. H. Harding, La Porte, Ind.; Caryl D. Haskins, Boston, Mass.; H. C. Higgins, Marinette, Wis.; A. L. Ide, Springfield, Ill.; Prof. Dugald C. Jackson, Madison, Wis.; F. Kellogg, Spencer, Pa.; P. H. Korst, Racine, Wis.; Fred. P. Luthy, Peoria, Ill.; J. S. Maurer; T. R. Mercein, Milwaukee, Wis.; Pliny Norcross, Janesville, Wis.; C. C. Paige, Oshkosh, Wis.; H. T. Pierce, Negaunee, Mich.; John Schuette, Manitowoc, Wis.; W. C. Shaffer, Milwaukee, Wis.; C. P. Williams, New York City; R. A. Willson, Marquette, Mich.; Wm. Wilson, Milwaukee, Wis.; H. C. Wirt, Schenectady, N. Y.

Safety Devices for Electrical Circuits.*

BY W. M. STINE.

Thermal-protective devices are as old as applied electrics and it would casually appear that such an ancient matter, electrically speaking, had long since received due consideration and one might see it rationally employed by manufacturers of porcelain goods and every central station as well. By a fuse wire we mean a metallic element purposely inserted into the circuit, its size and melting point being so adjusted as to make it the weakest element in the circuit; and further, its weakness being so carefully adjusted that it shall yield before the other circuit elements are harmed.

The principal points which have been investigated were the time element and uniformity of fusing; the carrying capacity as influenced by length, diameter, and enclosure; the effect of use, and the influence of the receptacle.

A motor should have as strong starting torque as possible, and wherever possible should be started up under a light load. Further, the starting resistance should be so proportional that the motor in starting shall take no more than normal running current. A more generally intelligent understanding of the limits of insulating materials will result in better care being taken of the circuits. The careful manager will protect his circuits from all undue strain and sudden heavy current rushes as carefully as he would avoid pounding in the engine, and for much the same reasons.

The uniformity of the fusing point of any given fuse wire is of the greatest importance. After considering the time element the whole question of the proper use of fuse wire depends on its uniform action. Too often this question of uniformity in action has been taken on blind faith, based on the carrying capacity in amperes stamped on the spool.

We have found from our tests that this uniformity in fusing depends very largely upon the active lengths of wire used. It also depends upon the coating or oxide film, on the contacts to which it is fastened, and whether the fuse is open or enclosed, and whether the fuse is extended clear of the receptacle throughout its whole length.

The terminals to which the fuse is attached have an influence upon its blowing. The tendency is to use terminals which are too massive. In this way their cooling effect extends over several inches of the wire and allows only the balance, and, usually there is none, to be truly effective. The cooling influence of the terminals can never be wholly avoided, but manufacturers of receptacles should endeavor to make it as small as possible.

From these generalizations we may turn at once to the results of tests.

To show the effect of the open and closed fuse blocks, a 5-ampere round fuse wire was timed to blow in just one minute. In the covered block it carried 20 amperes for this time, with a distance between the contacts of one half inch. In an open block, when the distance was seven eighths inch, the critical current was 15 amperes. To illustrate the effect of the length of the fuse on its blowing time, and as well to show the supposed accuracy of the maker's rating, an 8-inch length fused in one minute with nine amperes has been selected as a fairly typical case from among a mass of data.

To show the influence of the time element, a few tests may be cited. A 3-ampere wire carried 35 amperes for nearly one second, and a 10-ampere wire, 65 amperes, for the same time, and this, too, with the wires under the most favorable conditions, having a fusing length of eight inches. One may well ask the effect with the lengths ordinarily employed—our tests showed the currents carried are several times as large.

One of the most instructive curves which we plotted from our tests was a set showing the influence of the length of the fuse upon its carrying capacity. These curves showed that after a certain length was exceeded, which depended upon the size of the wire, that they fused uniformly with the same current. As an example, a

* Abstract of a paper read before the Northwestern Electrical Association.

16-ampere wire one inch in length fused at 28 amperes, two inches at 18 amperes, three inches at 17 amperes, four inches and over at 16 amperes. This definitely shows that this particular wire if used on its rating of 16 amperes should not be employed in lengths less than four inches; but if it is desirable to use it in a shorter length, the curve will indicate its capacity for such length. It would be an excellent plan for manufacturers to send out such calibration curves with their products.

In order to give the foregoing remarks a more tangible form, certain practical conclusions which we have already published in the proceedings of the A. I. E. E. for 1895 and elsewhere, may bear repeating.

1. Covered fuses are more sensitive and have a lower carrying capacity than exposed ones.

2. Fuse wire should be rated for its carrying capacity for the lengths ordinarily employed.

3. Fuse blocks should be made with greater distances between the terminals.

4. Fuses should be removed from time to time, as they become coated or fouled.

5. The time element should be considered when protecting parts liable to burn out.

6. Fuses up to five amperes should be at least 1½ inch in length; one half inch to be added to the length for each increment of five amperes.

7. Except for smaller sizes flat fuses are more reliable than round wires.

8. Round fuse wire should not be employed in excess of 30 amperes capacity. For higher currents flat ribboned exceeding four inches in length should be employed.

This subject cannot be dismissed without pointing out the duty of the manufacturer. The ordinary method of marking fuse wire is entirely inadequate. Each spool of wire should be accompanied by a curve or table clearly setting forth the carrying capacity for varying lengths. Better still, the use of wire should be discontinued, and fuses sold already mounted to copper terminals, plainly marked with their normal rating, which should be at least 80 or 90 per cent. of their fusing currents.

There is one form of mounted fuse almost universally used, which is highly objectionable, even though used only on small tap circuits. The screw fuse plug is here referred to. Not only is the length of the wire too short, but poor workmanship and liberal use of solder raises their fusing points to a dangerous degree. As a rule, their actual fusing points are double their marked ratings.

Mechanical Cut-Outs.—This division will necessarily refer to a class of apparatus in which the current is led through an electromagnetic coil connected by suitable mechanism to some form of switch, which under excessive currents shall open, either by magnetic or mechanical means. It is only fair to state at the outset that these devices involve points which admit of extended experiment and discussions, questions which relate mainly to the form of the actuating apparatus, but which for our present purpose need not be entered into.

A comparison with the thermal cut-out is at once suggested. The fuse wire is an indirect devise. The electrical effect must be transformed into heat energy, and the distribution of heat in a metal is always slow. In a mechanical cut-out whose vital member is an electromagnet, an excessive current acts immediately to open the circuit. There is here no transformation of energy and tardy distribution, as direct advantage is taken of the energy of the magnetic field which always accompanies an electrical current.

The discussion which follows is based on tests made upon electromagnetic cut-outs, representative in design and manufacture, of the leading styles on the market. As some of the old line electrical manufacturing companies have had circuit-breakers on the market for some years, these were not deemed of sufficient interest to test, as their design is antiquated and not representative.

The tests were designed to show the time element of opening the circuit, the effect of creeping currents and the reliability of setting.

As our tests will soon be published in detail with curves and tables, the discussion here will not enter into detail. The time element in all the cut-outs tested was found to be very small. Whether the device opened with a spring directly released by the electromagnet or indirectly by a blow, a minimum time element was soon reached, and this ranged from 1/30 to 1/20 of a second. These small times may be termed the inertia time constants of the cut-outs.

For sake of comparison with the fuse wire, Table I is instructive.

TABLE I.—TIME ELEMENTS.

Mechanical Cut-out, Round Fuse Wire, 25 Amperes.

Impulsive Currents.		Impulsive Currents.	
Amperes.	Time.	Amperes.	Time.
26.75	.099 sec.	25	300 sec.
27	.081 "	26	125 "
27.5	.081 "	27	103 "
28	.073 "	28	80 "
30	066 "	30	50 "
30	.066 "	40	25 "
40	.059 "	50	13 "
40	.059 "	60	8 "
50	.055 "	70	5 4 "
50	.059 "	80	4.8 "

In order to understand the effects of creeping and impulsive currents, the physics of cut-outs must be referred to. We have fully shown in various papers that the fuse is characterized by great sluggishness of action, due to the slowness in general of heat changes. This is one of its gravest defects. An electromagnet in which the iron core is relatively small is extremely prompt in comparison. Our tables show that the additional inertia time of the spring and mechanism is small. Compared with the fuse, the total inertia period of the mechanical cut-outs is very small.

In the fuse, the length of the inertia period is greatly influenced by radiation and conduction to contacts, so that creeping currents attain much higher values before the fuse blows than impulsive ones.

In the other class, the inertia period being almost wholly mechanical, the critical current of opening should be the same, whether the current is a creeping or an impulsive one. The following table exhibits these effects:

TABLE II.

Mechanical Cut-outs, Normal Capacity, 40 amperes.

Creeping Currents.		Impulsive Currents.	
Setting.	Opened Amperes.	Setting.	Opened Amperes.
20	18	20	17.2
30	25	30	22 7
40	30.5	40	30.3
50	39.6	50	37.5
60	44	60	43.5
75	53.2	70	52.5
80	64.2	80	62
90	70.4	90	70
100	84	100	77

There is but one principal factor influencing the reliability of the magnetic cut-out, the sticking of the mechanical parts. In those tested this was found to be so small it was negligible. What would occur should the cut-out not be opened for months and the parts become corroded, one cannot say. The reliability is clearly shown by Table III.

TABLE III.—REGULARITY OF OPENING.

Mechanical Cut-outs, Normal Capacity, 40 Amperes.

I.	II.	III.
23.75 amp.	50 amp.	57 amp.
24 "	50 "	56 "
26.75 "	48 "	56 "
23.75 "	50.5 "	56 "
23.75 "	50 "	56.5 "

In the choice of mechanical cut-outs, simplicity is of great importance. The electromagnet should contain but little iron, and the mechanism for opening the circuits should be powerful enough to ensure prompt and regular action.

In view of the foregoing facts the question arises, when to employ a fuse wire and in what cases should the circuit-breakers be used. This is a question to be decided by individual judgment, enlightened by a proper knowledge of the properties of both. It is advisable to keep fuse wires off switchboards entirely—they do not afford the requisite protection, and besides, foul the board. For protecting motors, except in the smallest sizes, fuses are not reliable, and circuit-breakers should invariably be used. The same plan is to be recommended for protecting transformers, though at present it seems rather impracticable. But in this same connection it is to be remembered that electromagnetic cut-outs act as efficient choking coils and lightning protectors. For such places as distribution closets and tap circuits the fuse leaves little to be desired, and it would be well were it confined to such uses exclusively.

Another matter which demands fuller treatment than can be here given to it is the protection of large electromagnets against high E. M. Fs. of self induction. Transformers and the fields and armatures of dynamos and motors are here referred to. Due provision should be made for absorbing circuits across the terminals of all electromagnets. The simplest form which this protection can assume is a circuit of one or more incandescent lamps placed across

their terminals. If the exciting currents in such magnets be suddenly interrupted, the incandescent lamps will absorb the energy which otherwise would spend itself in piercing and burning out the insulation. These lamps should be placed across the mains to such electromagnets between them and all switches and cut-outs.

Insurance as Affected by Electrical Construction.*

BY GEORGE S. M'LAREN.

In giving a paper on electricity as viewed from an insurance standpoint, I desire briefly to discuss the position taken by the underwriters in regard to its use and to mention a few of the greatest dangers to be avoided.

It seems to me that the more insurance companies insist upon good, practical, safe wiring and use of electrical apparatus the better it will be for the central station owners, the supply men and all concerned.

How evident it is to us all that the less trouble there is on an electrical system the cheaper it can run. If the mains and branches throughout the building are large enough to amply carry the current, and if there is no leak, you can certainly furnish cheaper and more satisfactory light.

Then again the person erecting a building receives a great benefit from the underwriters in the electrical line as well as in many others. He knows in the first place that there will be no danger from the wiring, and that the work will be done according to the most approved ideas. He has, gratis, some one who watches his contractors and their workmen, and who is constantly looking out for his interests, and he always has the satisfaction of knowing his equipment is thoroughly surveyed at least once a year.

Even the supply man and the contractor (provided they sell good material and do good, careful work) are aided by the insurance companies, for the underwriters are always ready to recommend the best goods and the most reliable workmen.

Instead, however, of taking this view many lighting companies try to furnish current to as many customers as they possibly can, and seem to base their probable profits upon the number of lights on their system instead of upon the actual cost of operating those lights. The company that takes on its system all sorts of equipments, composed of all kinds of absurd wiring, is not the company that will in the end make money; neither will the supply man who sells poor material, or the contractor who does careless work, profit in the long run. And here I would like to ask if, as an Association, we cannot do something to raise the standard of electrical work and electrical workers.

I would now like to mention a few of the greatest dangers to be avoided in electrical construction work. Many people consider that the greatest danger to be avoided is the possibility of a direct short-circuit. I do not believe this is true, for it has been my experience that short circuits almost invariably take care of themselves by immediately blowing a fuse or melting one of the wires, and thus cutting off the current.

More important points in wiring are: "The correct location of fuses," "the grounding of w res," "the wiring of fixtures," "the use of flexible cord," and "the placing of inflammable material near electrical apparatus." Let us discuss them briefly in the order mentioned.

Cut-outs should be centrally located, of easy access, and entirely separated from inflammable material. They should never be scattered promiscuously throughout a building. I do not believe in placing fuses in the canopies of fixtures or in rosettes for cord drops, especially not in damp places.

Slow leaks and the grounding of wires on gas and other pipes cause considerable loss each year. It is because the current consumed by these leaks is small but constant that there is so much danger in them. They do not take sufficient current to blow a fuse, but instead either form an arc or slowly work on the surrounding substance until they have become thoroughly charred and at last ignited.

Fixture work is an important branch of electrical wiring and should receive more attention than is generally given to it. I have as yet failed to find an entirely satisfactory wire and insulation for this class of work. If some manufacturer would introduce an insulation of small diameter which could not be easily cut and was still moisture proof it would find a ready market.

The use of flexible cord in electrical wiring is a matter of much concern to the underwriters. The number of fires caused by its use is surprising. We are now advocating the use of a cord with a solid rubber insulation of at least $\frac{1}{32}$ of an inch in thickness, which in turn shall be covered by a braid.

The principal troubles with cords occur in show windows and in draping designs in stores. Electric lights certainly look very pretty peeping out from under a mass of cotton-batting or from a pile of ribbons, but that such use of them is dangerous few seem to realize. The danger arises from three sources: First, the cord may become damp or may be pierced by a pin or nail, or may even have a defective strand, so that it will be short circuited or heated and catch fire. Second, the brass lamp sockets are not always in perfect order, or the cord attached to the binding screw may have a projecting fibre, because the man who connected it was in too much of a hurry to solder the ends. In either case the socket becomes heated or burned out and the material touching it catches fire. For this reason it is best to use porcelain sockets in show windows, theatres, etc. Third, the glass bulb of the lamp is liable to rest against some material which is ignited by the heat of the glass.

White tissue paper began to smoke after three and one half minutes at a temperature of 60 C., and after six minutes, at a temperature of 90, it burst into flame. Yellow woolen cloth smoked some after eight and one half minutes at a temperature of 100, but did not flame. It was badly charred.

A fire occurred very recently in one of our stores which is worth mentioning here. A bunch light composed of eight lamps, and attached by a cord, was placed on a pine box in such a position that two of the glass bulbs rested on the wood and the current was turned on. In 15 minutes the box was in flames.

In closing, I would like to speak of the actual insurance of buildings and the effects electrical wiring and apparatus bear on the "make-up" of their rates. To explain more fully I will briefly give an outline of how rates on buildings are determined. First, please understand that buildings are not rated by any mere guesswork; they are compiled by carefully consulted, accurate tables which have been deduced from statistics taken of all fire losses that have occurred for many years.

To illustrate this, the basis rate on a four-story building, whose area is not over 3000 square feet, is 55 cents. If the building has a larger area we add five cents for each 1500 square feet or fractional 500 square feet. If the building has deficient walls five cents is added for each story where they are deficient. Ten cents is added for a shingle roof, and five cents for wooden cornices. For skylights, well-holes and stairways we add five cents each, and for elevators 10 cents. Adjoining buildings cause an exposure rate of from 5 to 20 cents, or even higher, to be added. To all this is added a rate for the occupancy. Then the improvements on the risk are considered. Ten cents are taken off for electrical alarm connected with fire department, five cents for combined standpipe and ladder, 10 cents for automatic hatchways, 20 cents for watchman and clock, etc. The deficit rates are then added, and from them is deducted the sum of the amounts taken off for improvements. The result is the rate charged.

As electricity is comparatively a new feature in insurance, there are comparatively few statistics in regard to losses from its use, so it would be almost impossible to state how much increase should be added to the rate on a risk where, for illustration, weather-proof wire is used instead of the best grade of rubber insulation or when no spark arresters are placed on the arc lights. Moreover, it would necessitate large tables and considerable trouble to add or deduct very small percentages from a risk for every defect or improvement in electrical apparatus; therefore it has seeemed best to have a standard or set of requirements governing all electrical equipments and to require that this standard be strictly enforced. Where it is not carried out the insurance is cancelled. There are a few exceptions to this rule, *viz.*, where the general condition of the plant is not good a decided increase is sometimes added instead of the whole insurance being cancelled. This more frequently is done in small towns than in large cities. Then where a 500 volt current from the trolley wire is used 1 per cent. is added to the regular rate.

* Abstract of a paper read before the Northwestern Electrical Association.

Liberal Appropriation for Röntgen-Ray Experiments.

According to the New York *Sun's* London correspondent, the Prussian Government has appropriated $12,000 for Röntgen-ray experiments during the coming year.

An Expiring Patent on the Jacques Battery.

To the Editor of The Electrical World:

SIR:—My attention has recently been called to a patent which at this time ought to interest all those who are getting "electricity direct from coal."

Alexander Melville Clark, a patent agent, took out British Patent No. 1037, Feb. 26, 1883, on an "Improved Method of Generating Electricity, communicated to him by Henri Adolphe Archereau, of Paris, France."

In this patent he describes accurately and claims the Jacques battery and much more, as shown by the following quotation:

"I raise to igneous fusion potash or soda, or a mixture of the two, or the carbonate of these or other analogous bases. These oxides or salts being placed in a copper vessel, which is but slightly acted on by their contact, I immerse in the liquid the carbon to be oxidized in order to produce electricity. The copper vessels are covered exteriorly by an envelope of sheet or cast iron, etc., or a coating of a suitable material or composition to prevent the oxidation of the metal by contact with the air. Care should be taken that the carbon, which should be conductive, is insulated from the copper vessel, which becomes one of the elements of the battery, the carbon replacing the zinc of ordinary batteries and acting in a similar capacity, inasmuch as it becomes oxidized. But while fuel is burning in the ordinary way in a furnace to maintain at a red heat the oxides and salts above mentioned the heat tends to dissociate them, or does dissociate them in such manner that the carbon immersed in the liquid raised to igneous fusion sets free potassium and sodium and carbonic oxide, which burns by contact with the air at the surface of the liquid of the battery, and even also in the midst of the liquid when compressed air is injected therein. This air acts also by its oxygen on the immersed carbon and on the part not immersed, thereby generating electricity and the heat necessary for the accomplishment of the chemical reaction. In this way the potash, soda and even the carbonates become regenerated so as to always furnish oxygen (*sic*) to the carbon conductor, which is the electro-positive element of the new battery, wherein an indefinite quantity of carbon may be burnt, since the metallic elements potassium and sodium can always take from the air the oxygen to be given up to the carbon, which is to be renewed as it is consumed."

After describing other processes and modifications of this process, employing other fused salts, he concludes with four claims, the third being as follows:

"3. The mode of generating electricity by the combustion of carbon or other equivalent substance in a bath of potash, soda or salt of potash, or soda in a state of igneous fusion with or without the injection of air, oxygen or other gas, substantially as specified."

It also appears from the statement contained in this patent that he obtained about the same efficiency as that obtained by Jacques. He says:

"This invention relates to a method of producing electricity whereby about one third of the theoretical heat of combustible matters may be converted into electricity, and this by employing almost exclusively the oxygen of the air to develop energy by its combination with the carbon, etc., of the combustible matter."

Why has this great discovery been dying unattended for 14 years, and what has Henri Adolphe Archereau been doing all this time?

PHILADELPHIA, PA. C. J. REED.

"Qualitative Mathematics."

To the Editor of The Electrcal World:

SIR:—From the time when primeval man first began to count upon his fingers until less than two years ago mathematics has been a quantitative science, not to say the science of quantity, *sui generis* In the first half of the year 1895 Prof. Fessenden introduced to the world a new and weirdly strange kind of mathematics called "qualitative mathematics." To be sure, the Hamiltonian quaternions were a severe strain on the accepted ideas of quantity and there have been isolated cases of "qualitative mathematics" recorded, but there was never any recognized branch under that name until Prof. Fessenden introduced it. One of the isolated cases referred to is the following. Scene: The forecastle of an English ship. Jack Tar No. 1: "If an 'errin' an' a 'alf cost twopence, 'ow many 'errins can you get for a shillin'?" Profound silence and the puffing of pipes until finally interrupted by Jack Tar No. 2: "Say, Bill, did you say 'errins?" No. 1: "That's wot I said." No. 2: "Drat it all, I've been a-figgerin' on mackerel all this time."

In THE ELECTRICAL WORLD of May 4, 1895, Prof. Fessenden found the true dimensions of specific inductive capacity and permeability to be respectively $k = M^{-1} L^{-1} T^2$, and $\mu = M L$. These expressions were deduced apparently by some process peculiar to "qualitative mathematics" from equations (1) and (2) of his article. These equations, when operated upon by the process of the old fogy quantitative algebra, yield the results $k = T L^{-1}$ and $\mu = T L^{-1}$, as was stated by the present writer in THE ELECTRICAL WORLD of June 15, 1895. In the issue of June 29, 1895, Prof. Fessenden replied with what purported to be an explanation of the way that I had fallen into error, but now in the issue of Jan. 2, 1897, he gravely tells us that the dimensions of "specific inductive capacity $= T/L$," and "permeability $= T/L$," which differ only in notation from the above. The reason for this is quite evident. Prof. Fessenden had been figuring on mackerel when he ought to have been figuring on herring. In the first instance he was dealing with "an ether having the following properties: Its particles have no mass, it has friction (but no frictional losses, as its atoms have no kinetic energy); it has no inertia when moved in a straight line, but possesses inertia as a whole when moved in a curved line, the amount of inertia depending on the curvature." "Consequently, we see that the ether has inertia, depending on its density, and, second, on its curvature, for

$$m/L^4 = m/L^3 \times 1/L."$$

Here "m is the mass of the ether." It may be remarked that in ordinary mathematics if m is the mass of the ether, we would not say that the ether has no mass, but it must be remembered that this is "qualitative mathematics." In the second instance, Prof. Fessenden was dealing with another ether. "The ether got from this theory differs from the ether of Lodge, Heaviside and Kelvin and Larmor, in that frictional resistance to rotation varies as the square of the velocity and the pressure varies as the velocity. In other ethers the frictional resistance varies directly as the velocity."

In the issue of June 29, 1895, Prof. Fessenden explains that his results given in the issue of May 4 show "that the number of fundamental units must be increased to 10. When we know how electricity and gravity are related, then we can reduce these fundamental units from ten to three; the remaining three will be length, time and force." So confident was he that it was mackerel that he wanted everybody to adopt his results at once, and said: "It would appear as though it would be a good thing if we could commence the twentieth century with these changes." But now, having found that it is herring, he says: "There are three fundamental and eight quasi-fundamental quantities," 11 in all. The quantity appearing in the last communication for the first time is work, represented by W, but whether it is fundamental or quasi-fundamental is not stated, and the nineteenth century is still with us. What if before the twentieth century arrives the discovery should be made that it is neither fish, flesh, fowl nor good red herring?

"Qualitative mathematics" is beyond doubt a singularly, not to say uniquely, powerful instrument of discovery—of mares' nests. In this regard we yield to it *sine pevure palmæ*.

NEW YORK CITY. TOWNSEND WOLCOTT.

Electrical Engineering Opportunities in Mining.

A new occupation has been opened up for young men, says the *Engineering and Mining Journal*, since the introduction of electricity as a motive power in mining machinery. There has been a demand for men competent to install and maintain electrical machinery. This demand was at first supplied to some extent by the employment of those men who had been trained in the large factories making electrical appliances, but recently the work has been undertaken by graduates of some of the technical institutions of the country who are in this way acquiring practical knowledge which will be of the greatest service to them later.

Electric Lighting in European Cities.

According to the London *Electrical Review* the number of eight-cp lamps, or their equivalent, in some of the leading European cities is as follows: London, 1,300,000; Paris, 500,000; Manchester, 92,000; Glasgow, 70,000; Liverpool, 54,000; Edinburgh, 43,000. Of the total capital invested in electric lighting installations more than one-half falls to London.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Two-Phase Rotary Transformer.—Lond. *Elec.*, Jan. 8.—A well illustrated description, with the principal dimensions, of the Alioth transformer used at Geneva for transforming a two-phase current of 2400 volts down to a continuous current at 70 volts.

Repairs of Electrical Machinery. HARRIS. *Amer. Mach.*, Jan. 14.—An article giving an elementary description of the winding of a ring armature, which is intended to be sufficient for those who may be called upon to repair such machinery.

LIGHTS AND LIGHTING.

Geneva Exposition. RITTER. *L'Ind. Elec.*, Dec. 25; a conclusion of the descriptive article.—The total lighting at the exhibition amounted to 2618 incandescent lamps of 16 candle-power, and 402 arc lamps, thus corresponding to a total of about half a million candles.

Results of Incandescent Lamp Measurements. RIGGERT. *Elek. Zeit.*, Dec. 31; an article of some length intended to be supplemental to the one by GUSINDE, which was abstracted in the *Digest* last week.—He gives the results of the measurement, which have been made at that station in Hanover in accordance with the specifications given in that previous article. Eleven of the manufacturers contributed lamps, and the results of the test are given in a number of tables, the lamps being referred to by numbers and not by name; most of the interest in the article lies in those tables, which cannot be abstracted; among the other matters of interest may be mentioned the following: The photometric measurements were made with a Bunsen grease-spot photometer; as a secondary standard an incandescent lamp was used, which was compared 20 or 30 times with the Hefner standard lamp; to eliminate the errors, due to the screen, it was turned repeatedly through 180 degrees, an equal number of measurements being made in each position. The diagram of the connections is given; the voltage of the lamps could be adjusted to 0.2 volt; the secondary standard and the lamp to be tested were connected to the same source so that any variations in the voltage would not materially affect their relative value; it was therefore not necessary to keep continuing to adjust the voltage very accurately to follow any changes. The results of the measurement showed that most of the makers did not fill the requirements; the lamps of the same maker differed materially from each other, showing that the universal complaint of the way in which the lamps are sorted is justified; the results also showed that it is possible now to make the lamps quite uniform.

Lighting Drawing Offices.—Amer. Mach., Jan. 14.—An illustrated description of a system which has been adopted in some of the English cotton mills, and proved to be far superior to the usual systems. The incandescent lamps are supported by hanging rods, and are surrounded by opaque reflectors made of white paper in the shape of a cone, blue printed on the outside to render them more opaque (this latter precaution seems unnecessary as it does not increase the reflecting power from the inside, and there is no objection to transmitted light); the light is thus thrown on the ceiling which, together with the walls, is painted white; the light is stated to be even better than daylight and casts no shadows on the drawing board.

Incandescent Lamp Filaments.—Elec. Rev., Jan 13.—An article from the New York *Sun*, giving an interview with Eyre, superintendent of the lamp factory at Harrison, containing data which may be of some interest. Out of the 20,000,000 lamps used in the world every year about 90 per cent. are 16-cp lamps; the filament for this lamp is 0.004 inch in diameter and 10 inches long; it would take 140,000 of these to make a pound, and they cost $10 a thousand, or $1400 per pound; the total lengths of the filaments in a single pound amount to 21.3 miles. A brief history of the incandescent lamp is given. There are 30 lamp factories in the United States, only about half of which make their own filaments; those in the United States produce about 11,000,000 lamps per year, of which 6,000,000 to 7,000,000 are made in this factory; the price of a lamp has fallen from $1.25 to 20 cents.

POWER.

Power Transmission at Victoria Falls.—Lond. *Elec. Eng.*, Jan. 8.—A note stating that a project is under consideration and in the hands of a syndicate, for utilizing the power of the Victoria Falls on the Zambesi River and to supply it to the various centres of population throughout Rhodesia, Africa; the falls is believed to surpass in size the Falls of Niagara, and the scheme is said to be the greatest one projected in this century; a recent report of the undertaking has been made by Prof. Forbes; no data is given.

Electric Mining Machines.—Eng. News, Jan. 14.—A note stating that according to the report of the Ohio State Inspector of Mines for the year 1895, electric mining machines are coming into extensive use, and are displacing those using compressed air; in that year there were 82 air and 82 electric machines, while in the preceding year the numbers were 112 and 59.

Recent Advance in Power Transmission. MCGHIE. *Elec. Eng.*, Jan. 13.—A short article referring briefly to a few recent plants. According to the published figures of one of the largest companies, he states that during the past year the apparatus sold by that company for power transmission and power utilization purposes amounted to 75,000 horse-power.

Long-Distance Power Transmission.—Amer. Mach., Jan. 7.—A short article accompanied by a number of photographic illustrations giving a brief description of some of the installations of the General Electric Company, most of which have already been described at greater length.

Electric Motors in Factories. JACKSON. *Elec. Rev.*, Jan. 20; the first part of a reprint of a paper read before the Western Society of Engineers.—It gives a summary of the views held by the managers of a number of the great manufacturing establishments where experience has been had with electrical transmission and distribution of power. Considering first the comparative cost, he states that the first cost is nearly always considerably greater for the electrical equipment, even if the gain in efficiency is considered; this applies to a new establishment; in the case of an established concern this applies to a still greater degree. Considering the comparative operating advantages, he quotes from statements made by 14 establishments which support the view that it is questionable whether there would be any large annual saving if less than 250 horse-power are used. Regarding the annual expenses of repairs and the frequency and extent of failures, these statements show that there is an overwhelming feeling in favor of the use of electrical transmission; in establishments turning out a product of bulky or heavy articles the electrical equipment adds materially to the shop efficiency; where the articles made are small the electrical equipment adds to cleanliness.

Niagara Power in Buffalo. STETSON. *Elec. Rev.*, Jan. 20.—A reprint of his remarks at the recent Buffalo banquet.

TRACTION.

Electric Vehicles.—L'Ind. Elec., Dec. 25.—A brief description of the Darracq vehicle exhibited at the bicycle exposition in Paris, which is spoken of quite highly. The designer believes that oil engines should be used only outside of the large cities, and that electric vehicles are more suitable within the city limits. On this one there are 40 Fulmen accumulators, weighing 400 kilograms, capable of running the vehicles 60 kilometres on one charge; the battery is charged from a 110-volt lighting circuit; the normal speed is 15 kilometres per hour; the total weight is 1200 kilograms, with three passengers; the traction coefficient does not exceed 0 035; at 12 kilometres per hour on a level the mechanical power required is 137 kilograms per second, which represents 23 amperes at 76 volts; the capacity is 125 ampere hours at a rate of 25 amperes for five hours. Some of the systems of igniting the gas in oil engines by electricity are briefly referred to.

Electric Brake.—L'Ind. Elec., Dec. 25.—A note referring briefly to an electric brake which has been introduced on the steep grades at Havre; the motors are made to run as generators, and the current produced by them operates a magnetic brake which acts by friction and by the production of Foucault currents; a safety device prevents the braking action from becoming great enough to cause the wheels to slide.

Stationary Accumulators for Electric Railways. SCHROEDER. *Elek. Zeit.*, Dec. 31.—A reprint of a long and interesting paper of a practical nature, giving the experiences had on several lines, and including a number of load diagrams showing the very variable demand and the nearly constant supply from the generators. In February of last year an experiment was made on the Zurich-Hirslanden line to abandon the complicated switches for regulating the number of cells, and instead, to connect them directly in parallel with the generator; the result was very successful, and the station has been running in this way since; there is no regulator between the 270 cells and the generator; the current and voltage curves of the insulation are reproduced; the current of the line varied between 20 and 210 amperes during a period of 24 minutes,

while that from the machine, as a rule, varied only between 85 and 90; the voltage on the line was unusually uniform; this is due to the fact that the charges and discharges of the battery last for only a few seconds at a time and alternate repeatedly; in the charge and discharge curves of a battery the largest portion of the rise and fall is due probably to polarization, while only a small part is due to the internal resistance; with such rapid succession of charges and discharges only that part of the curve due to the internal resistance comes into action; batteries for this purpose should therefore be built with as low an internal resistance as possible; the battery on this line has been in use for over two and a half years, and there are as yet no signs of its deterioration; the coal consumption is 2.42 pounds per car km, which is very small considering that the steam engine is only one of 90 horse-power and the grades on the line are exceptionally heavy. He then discusses the results on the Meckenbeuren-Tettnang line, which is the first one in Germany the gauge of which is the same as that of the steam-railway lines; its length is 4.5 km and there is an almost constant up-grade in one direction; the power is obtained from two turbines two km beyond one end of the line; each car has two motors of 25 horse-power each and is capable of drawing two ordinary freight cars; as the same water-power is used for lighting purposes, considerable trouble was caused by the fluctuating demand for the railway, and a battery was therefore introduced which can deliver 80 amperes for half an hour continuously; the connections are the same as those in the first case given; the dynamo is compound wound, but in being connected parallel with the accumulators the series winding was cut out; it can develop 700 volts, which corresponds to only 2.20 volts per cell; the batteries must be charged fully, above this, once a day, and for this purpose it is divided into three equal groups, two of which are charged in series, and with a convenient switch the groups are alternated so that each is charged fully, thereby avoiding the use of a booster and its driving machinery. The accumulators can also be run in parallel with a reserve steam plant at the other end of the line; the load curves are given, showing that the load on the engine is remarkably uniform; the voltage varies only between 630 and 680, which increases to 700 when there is no line current; formerly it varied between 300 and 800 volts; before using the accumulators it was impossible to have two trains going up hill at the same time, but this is now quite practicable. He then gives the results with the railway in Remscheid, which line is composed almost entirely of grades, some of which are very heavy; the generators are driven by steam power, and the load curve is an exceptionally variable one, there being also a stationary motor load on the station; owing to the continuously increasing demand for the stationary motors a battery was the only feasible means for providing for the increase. As it was very important to keep the voltage constant, a system devised by the Siemens & Halske Co. was used; in this the booster dynamo has two windings which act in opposition to each other; one of these is a shunt to the battery, while through the other current to the line passes; when the demand is equal to the output of the dynamo the accumulators neither receive nor give current and the voltage of the booster is zero; that is, the two windings must balance each other; when the demand is greater or less than the output of the dynamo this booster will discharge or charge the battery, respectively, owing to the difference in the ampere windings of the two coils; in the installation itself, this differentially wound dynamo is made to be the exciter for the large booster which generates the necessary voltage; both the exciter and the booster are driven by an electric motor of 90 horse-power; the current and voltage curves are given; the voltage varies only between 495 and 510, due to the accumulators alone; with the aid of the booster the variation is reduced to 10 volts; the booster is therefore used only in the evenings when there are lights on the circuit; the dynamos are compound wound, but the series winding was cut out. For installations in connection with accumulators, a dynamo should not give as constant a voltage as possible but it should with the smallest variations of the current gives great variations in the voltage; the object should be to generate a constant power in watts, as the conditions will then be the best for loading the engine most economically. The generator used at Hirslanden varied the current from 72 to 102 amperes for a difference in voltage of 25, and at Remscheid 115 to 150 for 15 volts; most of the railway generators which he examined are quite suitable for use with accumulators, but if they were specially built for this purpose they would be still more satisfactory; the accumulators should be constructed so as not to vary too much in the voltage. At Remscheid it is possible now to stop the engines an hour earlier and not to begin until 7 in the morning. Accumulators can be charged to nine tenths of their capacity by direct connection without a booster, but for the other tenth a booster is necessary; it is possible now to use fewer of the generators, and there is a saving of about 24,000 pounds of coal per week, which amounts to a gain of about $1500 a year; this shows that even in the immediate neighborhood of a source of cheap coal, a very considerable saving can be had by the use of the accumulators, and besides this saving 200 horse-power has become available for an increase in the output of the plant; the cost of this much machinery is about double that of the accumulators. In the discussion Kallman called attention to the advantages of placing the accumulators at distant ends of the line. Schroeder stated that in this case the regulation will be still more favorable; he did not favor running separate feeders from different parts of the battery so as to use different voltages. Kugel remarked that practical tests would soon be made in other directions; he suggested the use of batteries connected with portions of the line, such as on grades where there is a greater demand for current, offering this as a substitute to increasing the size of cables. The accumulators should be charged completely daily, but for this 15 minutes is all that is necessary; the generators may readily be so made that they can be run at a higher voltage so as not to require a booster.

Surface Contact System.—Elec. Rev., Jan. 20.—A reprint from a London journal of an article describing the Claret-Vuilleumier system which is used in Paris; attention was called to a description of this a number of times before in these columns.

Railway Conduits for New York.—Elec. Eng. and *Elec. Rev.* Jan. 13.—An illustration accompanied by a very brief description of the conduit which will be installed by the Metropolitan Railway Company of that city on a number of its lines. The entire depth of the yoke is only 2 feet 6.75 inches, thus requiring only a very shallow excavation; the yokes are 5 feet between centres and the hand holes where the insulators are attached are 15 feet apart; the two conducting rails have a T-section; the rails will weigh 106 pounds to the yard; ducts for the feeders will be laid on the inner side of the conduit directly under one of the rails.

Conduit Railway System. LAW. *Elec. Eng.*, Jan. 13.—A brief description of the advantages of the Love system; among these are that the cost of maintenance is as low as for any known power; that it does not increase the cost of insurance along the line of the road; that the liability of breakdowns has been reduced to a minimum and when there is an accident the repairs can be readily made; the slot rail thoroughly protects the conductor from all sleet or mud; all the insulators can be easily reached from the surface; the trolley will run 20,000 miles without repair other than wheels and bushings, and the trolley wheels will make more than double the mileage of that of overhead lines; the cost of maintenance has been proved to be lower than for the overhead system.

Mining Locomotive.—Eng. & Min. Jour., Jan. 16.—A brief description of the Thofehrn locomotive, two of which are now used at the Anaconda copper mines, where they were installed about three years ago. It can pass through a tunnel 4 feet high and 3 feet wide; the power can be taken from an ordinary lighting circuit; this also reduces the danger in wet mines. Good working drawings with the outline dimensions are given; the gauge is 20 inches; the draw-bar pull 1000 pounds; the wheel base is 22 inches.

Union Loop, Chicago.—West. Elec., Jan. 16.—A brief description, with some illustrations, of the power-house and elevated railway, which is now nearly completed, and which furnishes terminal facilities in the down-town district to the four elevated railway companies of that city.

Meckenbeuren-Tettnang.—West. Elec., Jan. 16.—A brief, illustrated description of this mountain road in Switzerland, of which some descriptions in foreign journals were noticed in these columns some time ago.

Continuous Rail.—West. Elec., Jan. 16.—A reprint of the editorial noticed in the *Digest*, Jan. 9.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Free Lamps. GIBBINGS. Lond. *Elec. Eng.*, Jan. 8.—A reprint of the conditions of the free supply of lamps at the Bradford station, where this feature was recently introduced. Briefly, it is that a lamp is supplied free of charge for every 60 kw-hours consumed during the preceding half year; the applicant must produce the receipts for his bills, and if they are not paid before the last day of the second month he forfeits his rights to any free lamps to which he may have been entitled; the lamps are obtainable only at the end of every six months ending in June and December; the station will not recognize any breakage, defects or accidents the applicant being required to ship the lamps from the station at his risk; each lamp will have been carefully tested and examined before delivery.

Graphical Central-Station Diagrams. J. H. *Elek. Zeit.*, Dec. 31.—A short article describing a simple graphical method for showing some useful data connected with the operation of central stations. In the example with which the method is illustrated, he compares a continuous-current and alternating-current station, the figures for which were recently given by Goldenzweig; the conditions of operation in the two are about the same, and they have both been in operation in Vienna for some time. The diagrams show rectangles cross-patched in different ways so as to be easily distinguished from each other; the abscissas represent the number of total hectowatt-hours which have been delivered by the station during each of the completed years, showing the growth of the output during the respective years. The negative ordinates represent the capital invested in the construction per hectowatt-hour useful output. The comparison of the rectangles thus drawn show that the capital per unit in the alternating-current station is much lower than in the other; for convenience in comparison a small rectangle is shown indicating an investment of about $160,000. The positive ordinates give the net cost of operation, the dividends, the sinking fund, income, etc., the rectangles formed thereby being shaded differently. A comparison of these show that the costs of operation per

hectowatt-hour are larger for the continuous-current station especially if the interest and the amortization are included, the difference in that case for the last year being 41 per cent.; in the alternating-current station quite a large sum is set aside yearly for the enlargement of the different funds, while very little is left for this purpose in the continuous-current station.

Continuous-Current Transformer System.—Lond. *Elec.*, Jan. 8—A brief description of the modifications which have been introduced at Wolverhampton in the Oxford system; the generating plant has been simplified and the low-pressure distribution arranged on a three-wire system; a diagram is given of the circuits in a remote district; in this system a high-tension direct current is transformed down to a low voltage in local, rotary transformers.

Central Stations in the United Kingdom.—Lond. *Elec.*, Jan. 8.—The usual annual supplement of a colored map showing the central stations, and whether continuous or alternating, owned by a company or municipality, or in progress of construction.

Launceston. *Elec. Eng.*, Jan. 13.—A brief description with two illustrations, of the plant referred to in the *Digest* last week.

WIRES, WIRING AND CONDUITS.

Junction Blocks.—Lond. *Elec.*, Jan. 8.—An illustrated description of the Jeckell system, intended for covered cables drawn into cast iron pipes; it overcomes the difficulty in making connections.

Baltimore Electric Subway System.—Elec. Eng., Jan. 13.—An extract with some of the illustrations of a recent, voluminous and exhaustive report by Hill, whose plans the commission recommends for adoption by the City Council. He favors municipal control of the subways; a map shows the area within which the wires are to be placed underground and beyond which pole lines are to be used. He recommends the "drawing in" system, the use of terra cotta conduits, and the delivery of fresh air to the manholes by air compressors operated from a central station. The rentals for ducts would be 15 cents per foot for wrought iron tube construction, and 9.25 cents for the tile construction, both for three-inch ducts; cement lined tubes would be 12.25 cents; for two-inch ducts it would be about 7 cents; the subways are to be built at least 50 per cent larger in capacity than the present service requires; curves of the cost are given, as also illustrations of the system recommended.

Manufacture of Insulated Wire. Perrine. *India Rubber World*, Jan. 10.—A long article describing the manufacture of insulated wire, for which the usual rubber compounds are used; also the manufacture of lead-covered wires and cables; the article is chiefly of interest to manufacturers.

Switchboards. Davis. *Elec. Eng.*, Jan. 13.—A continuation of his article on the evolution of isolated plants, the present portion being devoted to the evolution of the switchboard and is accompanied by some illustrations.

Machinery for Cable-Making.—India Rubber World, Jan. 10.—A short, illustrated description of a cable-covering machine made by a prominent English company.

ELECTRO-PHYSICS AND MAGNETISM.

Temperature of the Arc. Wilson and FitzGerald. Lond. *Elec.*, Jan. 8.—A reprint of a Royal Society paper on the effect of pressure in the surrounding gas on the temperature of the crater of the arc. They give corrections of the results arrived at in a former paper read in May, 1895; the primary object was to determine whether the temperature of the crater in the positive carbon varies when the pressure in the surrounding gas is changed; they conclude that either the temperature of the crater is not that of boiling carbon or else the latent heat of volatilization of carbon is very considerably greater than that calculated from Trouton's law; the experiments throw considerable doubt on the probability that it is the boiling point of carbon that determines the temperature of the crater.

Magnetic Fields of Coils. Everett. Lond. *Elec. Eng.*, Jan. 8.—A reprint of a Physical Society paper which was read Nov. 8, 1895 with additions to it. He gives formulas applying to a cylindrical coil of any shape or cross-section, proving the formulas, and giving some examples illustrating their use. The formulas are based on Ampere's rule for the force due to an element of current.

X-Rays. Cornu. Lond. *Elec.*, Jan. 8.—Translation of his annual address to the French Academy of Sciences. He gives a brief historical account of X-rays, including nothing new.

Cathode and Other Rays. S. P. Thompson. Lond. *Elec.*, Jan. 8.—A communication in which he refers to the results of his recent experiments. In repeating the experiments of Fleming (see The Electrical World, Jan. 16, p. 97) he noticed that there was an intermediate stage at which the second large cross appears faintly before the first has diminished down to nothing; when the second cross makes its appearance a third shadow of a cross also begins to be formed, but not against the end of the tube; it appears distorted into a jagged ring around the body of the tube and on the other side of the object, as though the cathode rays, which had cast it, had been cast from that end of the tube where the shadow appears; the cross rotates 180 degrees in the operation of closing up. Regarding Prof. E. Thomson's observations (see *Digest* last week), he calls attention to the observations which he, the present writer, made in the Spring; more recently he examined the question whether the internal rays that cast this bright fluorescence are of the same kind as the Röntgen rays, and he comes to the same conclusion as Prof. E. Thomson, but on quite different grounds. It appears that when the cathode discharges impinge on the oblique platinum, they give rise to two different genera of rays, each genus including many species or varieties; the rays of one genus pass through the glass, are not deflected by a magnet, and hence are not Röntgen rays; under certain conditions the latter rays are electrostatically sensitive ; they are not simply reflected cathode rays for they do not follow the law of reflection and they have slightly different properties; like Röntgen rays they are not emitted from the platinum plate in accordance with the law of the emission of light, but on the contrary the intensity of emission is more nearly equal in all directions, even growing more intense in the angles that graze the surface. The theory of Sir George Stokes attributes the Röntgen rays to the sudden reversal of the movement, on impact, of electrified, charged molecules, giving rise at the moment of reversal to an electromagnetic disturbance which travels as a solitary wave instead of a train of periodic waves; it is thought that this is the nearest approach yet made to a consistent explanation of their origin.

Röntgen Rays. Barr and Phillips. Lond. *Elec.*, Jan. 8.—A short communication referring to the recent article of Fleming (see The Electrical World, Jan. 16, p. 97).—They had observed this twisting of the cathode rays some months ago; when the coil carrying the current is placed behind the cathode and with its axis on the line joining the cathode and anode, the spark resistance of the tube could be decreased or increased by switching on or off a current in the coil; at a high vacuum this effect became strongly marked. They obtained very interesting and beautiful results by using a concave cathode with a hole at its centre, the solenoid being slipped over the tube behind the electrode; a description of these experiments is promised.

X-Rays and the Blind. Barr. Lond. *Elec.*, Jan. 8.—A communication criticising the recent proposal of Edison pointing out the difference between a purely accidental result and one which is arrived at by means of systematic and rational experiments.

Non-Phosphorescent, Highly Fluorescent Materials. *Elec. Rev.*, Jan. 20.—A note stating that Kinraid has found a combination of chemical elements which fluoresce much more than tungstate of calcium or any of the other salts, and is absolutely non-phosphorescent; owing to this property the images on the screen are in some respects quite different.

ELECTRO-CHEMISTRY AND BATTERIES.

Production of Coloring Matters by Means of Electrolysis. Lond. *Elec. Rev.*, Jan. 8.—A brief description of a process used in a large factory in Germany; it is for producing some new yellow mordant dyeing coloring matters by the aid of electricity; 10 kg of dihydroxybenzoic acid dissolved in 40 kg of 63 per cent. sulphuric acid are placed in the cell containing the positive electrode; the negative electrode, separated by a suitable diaphragm, is immersed in sulphuric acid; a current of 20 amperes per square decimetre of anode surface at about eight volts is passed through the solution; when the reaction is complete the melt is poured into water and worked up by chemical methods, the resulting products giving strong fast yellow shades. Another process for cotton dyes is now being tried; in the manufacture of Congo red the oxidation is produced by means of an electric current instead of by sulphuric acid.

Extraction of Antimony. Jones. Lond. *Elec. Rev.*, Jan. 8.—A brief note describing his process used in gold bearing ores. The powdered ore is treated with hydrochloric acid in a closed vat in which it is heated, the hydrogen sulphide being collected; when the acid is saturated with antimony it is filtered and electrolyzed, the chlorine being passed through the hydrogen sulphide tank, precipitating the sulphur and forming hydrochloric acid, which is then used over again; the electrolyzed solution is also returned to the dissolving vat; the ore thus freed from antimony contains all of its gold.

Separating and Refining Metals by Electrolysis. Tommasi. Lond. *Elec. Rev.*, Jan. 8.—A brief abstract of an article from the July number of the *Moniteur Physique;* a similar series of articles by that author on this subject was referred to in the *Digest* some months ago.

Electro-Chemical Production of Metallic Sulphides. Lorenz. Lond. *Elec. Rev.*, Jan. 8; a brief abstract of a translation of a paper in the *Chem. News*, Oct. 16, describing a general method.—Any metallic sulphides can be precipitated by this process from a neutral solution if it is insoluble in water, without the use of sulphuretted hydrogen or a metallic sulphide; a cathode of copper sulphide is used with an anode of the metal whose sulphide is to be obtained; the electrolyte is an alkaline chloride, nitrate or sulphate.

Copper Refining. Kershaw. Lond. *Elec.*, Jan. 8.—A short article on the history and progress of electrical copper refining, including a table containing a list of the copper refineries in Europe and North America with their estimated output, and the name of the system used. He estimated that at least 100,000 tons of raw copper are now treated by electrolytic methods, and that this represents over a quarter of the entire copper output of the world.

Electrolytic Bleaching Solutions. Lond. *Elec. Rev.*, Jan. 8; a brief abstract from *Dingler's Jour.*, Vol. 301, page 234, describing the Kelner-Hallein apparatus for electrolyzing salt solutions.—It is adapted to be run by currents from ordinary lighting circuits, and the cost of installation is low; the tank is divided into separate compartments by bipolar electrodes made of plates of ebonite with brush-like projections of platinum, allowing the use of high-current densities.

Silichromite.—L'Ind. Elec., Dec. 25.—A new product of the electric furnace obtained from a mixture of natural chromic iron, sand and carbon together; it is an extremely hard crystallized mass, is easily powdered and is used as an abrasion material.

Purification of Beet Root Juice. SCHOLLMAYER'S process. Lond. *Elec. Rev.*, Jan. 8.—A brief abstract from *Dingler's Jour.*, page 258, vol. 300, describing this process.

Electrolysis of Water. SOKOLOFF. Lond. *Elec. Rev.*, Jan. 8.—An abstract with some data of the article noticed in the *Digest*, Jan. 2.

Electrochemical Industries.—Lond. *Engineering*, Dec. 25; reprinted in the *Elec. Rev.*, Jan. 13.—Attention is called to the immense number of proposals and patents, and to the difficulty of obtaining industrial facts; processes are described in journals and books, none of which are worked on an industrial scale. The actual production by electrolytic methods of either chemicals or metals is less in Great Britain than in either America or Germany; one chlorine and soda factory has started on a large scale at Helens, but there have been so many accidents to their turbines and dynamos that very little of their product has been put on the market; the Hargreave's process for producing chlorate of soda is working satisfactorily at Northwich; the Castner-Kellner works at Weston Point are progressing, but nothing has been produced; three aluminum works have been started in England during the past five years, but have been stopped owing to the rapid fall in prices, and none of them are working at present, although the works at the Falls of the Foyers will be in operation next year. In France, Germany and Switzerland there is a much more flourishing condition of affairs, due partly to their water-powers and to their better trained scientists; all of the undertakings appear to be prosperous; in Norway great preparations are being made for utilizing the waterfalls. The most successful development of electrochemical and electrometallurgical industries is in the United States; the whole number of plants for electrolytically refining copper is 20; there is only one company producing aluminum and one or two at Niagara Falls for producing chlorate of potash; chlorine and soda are made at Saltville, Va. The Siemens and Halske gold extraction process is most promising, and is used by eight mining companies in Africa, who treat 60,000 tons of tailings monthly; this may quite displace the old zinc precipitation process.

Production and Use of Carborundum. Eng. & Min. Jour., Jan. 16.—During the past year the production of the company making this material was 595.25 tons of crystalline carborundum; only the crystalline form is produced at present, but it is thought that this material will also probably take the place of ferro-silicon in the manufacture of steel; if the cost does not exceed 6 cents per pound the demand in Germany alone will be 2500 tons annually. The present company is prepared to furnish the amorphous form at a price slightly smaller than this figure.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Magnetic Balance. EBELING and SCHMIDT. *Zeit. f. Instrumentenkunde* — December; noticed briefly in the Lond. *Elec.*, Jan. 8.—A communication from the Reichsanstalt giving a description of the Du Bois balance which is used extensively in Germany for printing the magnetic properties of iron and steel; they investigated the errors introduced by the earth's field which may be eliminated by superposing the negative on the positive branch of the hysteresis curve, and assuming the one midway between the two to be the true curve.

Recording Volumeter.—Lond. *Elec.*, Jan. 8.—An illustrated description of a new instrument for central stations. The clockwork, instead of being in the drum as usual, is firmly fixed to the frame of the instrument and the record sheet is a long strip of paper which passes under the recording pen; the apparatus holds a supply for one month and the last five or six hours' record can be seen from a window in the case; the record can be torn off if desired; one inch corresponds to one hour.

Magnetometric Observations. DU BOIS. *Elek. Zeit.*, Dec. 31.—A short article suggesting a number of methods by which magnetometric observations might be made, free from external magnetic disturbances; the principles only are given, as it seems that the methods have not yet been applied in practice. There are two kinds of actions, the one to be measured, and the disturbing one; the former changes from point to point, and the latter, which though not entirely free from changes, may, however, as a rule, be represented by a constant horizontal component within a reasonable distance. It is possible therefore to use an auxiliary magnetometer, which is placed in a position where the forces to be measured are zero, but where the disturbing forces are the same; the readings of this can then be deducted from those of the other instrument. It might be possible also to use two magnetometers at different distances from the magnet to be tested, and in one of the well-known relative positions used in the Gauss method; if the disturbances are equal in the two places, the difference of the readings will be proportional to the magnetic moment of the magnet. He describes a system in which there is an astatic pair of needles placed above or in the line of the axis of the magnet; the reduction of these methods to practice will involve some difficulties, to overcome which he suggests still another method which, however, is not very clearly described; it is based on the so-called unipolar method in which the magnet to be tested is placed vertically; the arrangement was calculated and tested experimentally by Nagoka at the suggestion of the present writer; it appears that a vertical magnet suspended on a horizontal axis, and having the shape of an ellipsoid, is contained in the inside of a coil through which a current is passed, and an astatic system of needles is placed on the outside in certain definite positions, one of the needles being in or near the point of maximum deflection and the other being in the central plane where there is no horizontal component.

Apparatus Showing Phase Difference. DERR. *El'ty*, Jan. 13; also *West. Elec.*, Jan. 16.—A reprint of the paper abstracted in the *Digest*, Jan. 16.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Speed of Electrical Impulses Over Iron Wire. CAMP. *Teleg. Age.*, Dec. 1; reprinted in *West. Elec.*, Jan. 16.—A short article describing some speed tests made by connecting a large number of telegraph lines together. One of the circuits was 15,310 miles long over which the average time to complete a double circuit was 1.06 seconds; allowing 0.02 second for each of the 26 repeaters gives a speed of 28,600 miles per second.

Telephone Exchange Building at Savannah.—Elec. Eng., Jan. 13.—An illustrated description of the new building.

Printing Telegraph. Elec. Rev., Jan. 20.—A short note stating that the apparatus devised by Prof. Roland, of Baltimore, is nearly ready for commercial use; it will transmit a telegram written on the typewriter; 10 or 12 messages can be sent simultaneously on the same wire, half in each direction; the principles are said to be entirely different from those of other typewriting telegraphs; it involves the use of a synchronous device; there are only eight signals, the letters being produced by combinations of these; the current can be relayed.

Ocean Telephony. Elec. Rev., Jan. 20.—A reprint from the New York *Herald* of a recent interview with Edison, in which he stated that in his opinion telephoning across the Atlantic will be impossible. He also stated that if the poles could be erected three miles high it would be possible to telephone around the world; but he thinks the difficulties will never be overcome.

New Book.

THEORY AND CALCULATION OF ALTERNATING CURRENT PHENOMENA. By Charles Proteus Steinmetz, with the assistance of Ernst J. Berg. The W. J. Johnston Company, New York, 1897. 449 pages, 184 diagrams. Price, $2.50.

This work embodies the results of an investigation that has extended over several years. The important feature above all else is the solution of alternating-current problems by means of "complex quantity." In a paper read before the American Institute of Electrical Engineers, April 18, 1893, Mr. Kennelly called attention to the fact that the algebra of complex quantity is peculiarly well adapted to the solution of problems relating to alternating current phenomena. Mr. Steinmetz at that time remarked that Mr. Kennelly's statement, which was contained in one short paragraph, was of the utmost importance, and he accompanied his remarks by practical examples, giving a number of solutions of problems of as representative a character as possible.

At the Electrical Congress held at Chicago in 1893, Mr. Steinmetz read an elaborate paper on the same subject in which a great deal of ground was covered, and now in the present work the method is exhaustively treated.

The work is intended for practical use; that it is expected that engineers who have to deal with alternating currents will actually use the book on their practical work. The author is not a college professor striving to create a reputation for profound wisdom, but a practical designer of alternating-current machinery for one of the largest manufacing companies in existence, and he really uses his own methods.

It is a brave doctor who will take his own medicine, and it is safe to say that if some of the authors who have written on alternating currents had to earn a living designing alternating-current machinery, they would soon consign their own methods to "innocuous desuetude."

The student of algebra, at a very early stage of his studies, becomes acquainted with negative quantity, and in the vast majority of cases masters the philosophy of the subject without difficulty. But the case of imaginary quantity is somewhat different, for although an imaginary expression has, under certain circumstances, a perfectly definite meaning, just as a negative real expression has, yet there has been an air of mystery about the subject, and only a very small number of those who master negative quantity have a working knowledge of imaginary quantity. We do not wish to frighten off prospective readers, however, but, on the contrary, we would recommend the work to all electrical engineers, and it may not therefore be out of place to make a few remarks that will put beginners on the right track.

There is a somewhat prevalent impression that imaginary quantity has no real significance except a geometrical one. This is no more true than

a corresponding statement regarding negative quantity would be. To be sure, any case where imaginary quantity has a real significance may be graphically represented by a geometrical construction, but the same is true of negative quantity. Some quantities (for instance, energy) are often regarded as essentially positive, and negative values obtained are evidence of errors in the mathematical process. This, however, is merely a matter of statement of conditions. If we have a problem involving the total energy of a system of bodies, the energy is essentially positive, so far as that problem is concerned, but if we call the work done by A on B positive, then work done by B on A is negative. Just so distance *per se* is an essentially positive quantity, and if any one said that he had walked 10 miles negative, or minus ten miles, the statement would be absurd, except in the light of the conditions imposed by assuming a certain direction in space as positive, when negative distance would acquire a real meaning. But so also by another convention imaginary quantity, positive and negative, represent the two directions at right angles to positive and negative real quantity.

For instance, if the positive direction be north the negative will be south; then if the positive imaginary be east the negative imaginary will be west, and intermediate directions will be represented by complex expressions; that is expression containing both real and imaginary terms.

The expression $\pm a \pm j b$ would represent this. First move from the origin or starting point a, units north or south according as a is + or —, then move b units east or west according as b is + or —, then consider the *straight line* connecting this point with the origin. This line is a vector, and graphically illustrates the complex algebra, but it must be ever borne in mind that electric currents and E. M. Fs., although so successfully treated in the present volume by complex algebra, are distinctly *not* vectors. A continuous current or E. M. F. is not a vector, much less an alternating current, especially when we are dealing with the effective or square root of mean square value. It is this confusion of real vectors with other magnitudes which have no proper directions in space or other proper special relations, but which are susceptible of treatment as vectors in the graphical method, that has perpetuated the erroneous theory of the rotary field in polyphased apparatus, to say nothing of that outrage upon electrical science, the "rotary current" or "drekstrom." Polyphased apparatus may be built so that there is a rotary field, and it may be and is built in practice without a trace of it.

The complex algebra, although the central feature of the book, is not the only point of interest. Two graphical methods are described, one of which is very original, and is called by the author the "topographic" method. The assumption of an "equivalent sine wave," that is a simple sinusoid square root of mean square value is equal to the corresponding value of the given wave however complex that wave may be, has been adversely criticised, especially by English electricians. This assumption is at the bottom not only of the methods of this book, but of all other systematic modes of treatment of alternating current phenomena, and although it may be open to criticism from a theoretical point of view, its practical accuracy has been demonstrated, and moreover the theoretical objections do not apply to the method as a whole, but only to some of the less important consequences.

The method of allowing for the effects of hysteresis is valuable to the practical designer, as these effects have heretofore complicated calculations in a serious manner. A simple method of dealing with these effects, if leading to practical results, is not to be despised, even, if an empirical one.

Mr. Steinmetz's standing in the electrical profession as an engineer, the practical use which he has made of mathematical analysis and the fact that this work embodies the results of practical experience in the successful application of mathematical deductions to the design of alternating-current machinery makes the book of the greatest value to those interested in alternating-current phenomena.

Illuminated Mouthpiece.

Electrically Illuminated Mouthpiece for Speaking-Tubes.

The demand for a speaking-tube by which the caller's attention can be attracted easily at night led the Eagle Electric Manufacturing Company, Pittsburg, Pa., to design a mouthpiece for such use, which is claimed to be the best ever produced. It is made in a very neat and compact manner and can be easily applied wherever a speaking tube is used. It is made of the best hard wood, lined throughout with plate mirrors, and all parts are finely finished in nickel. It is lighted by two 2-cp lamps and can be operated by a dry battery or a small storage battery. The system is so arranged that only three wires are needed to operate the push buttons and mouthpiece.

Special designs are made with or without mouthpieces for advertising purposes, and when the lights are in operation they present a very attractive appearance.

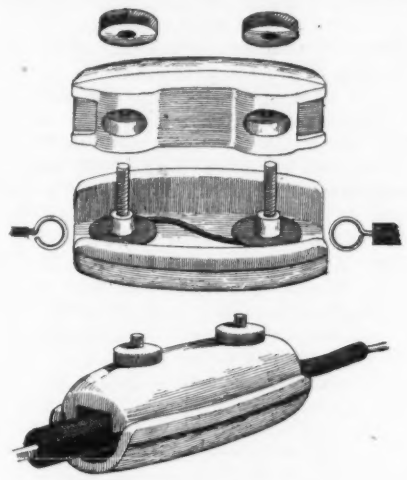
The Eagle Electric Company manufactures dental engines to be operated by storage batteries and in a short time expects to have its new alternating-current dental engine on the market.

The company's works are equipped with modern machinery for the manufacture of fine electrical goods and the company handles a line of one of the best storage batteries on the market.

Self-Insulating Fixture "Bug."

The most recent inspection regulations prohibit the use of the ordinary taped fusible cut-outs or fixture "bugs" usually placed in fixture canopies and connecting the fixture with the outlet wires. It has therefore been the practice to make either hard connections or cover the "bug" by some fireproof insulating shell, which is usually entirely separate from the cut-out proper, and is easily misplaced when re-fusing is necessary, and a condemned covering of tape substituted. The fusing of each separate outlet on a circuit has certain advantageous features if such protection as above mentioned could be absolutely assured.

With this object in view the Reynolds "bug" was devised. With this device it is necessary to entirely cover all conducting parts of the fuse cut-out before the proper connection is made. The "bug" has practically no contact terminals, and consists simply of two porcelain parts.



Insulating "Bug."

The fuse is provided with two internal projections or studs. A washer is placed over each stud, and the fuse wire is placed beneath the washers. The fixture and outlet terminals are looped around the studs over the washer, and the porcelain cover is then placed on top and held to the base by the small nuts which engage with the screw pins projecting through the studs and cover. This brings the fuse and wire terminals into intimate contact, and at the same time entirely protects the fuse. The small size of this cut-out and the fact that no tools are required to re-fuse it will be particularly appreciated where small fixture canopies are used.

Mr. S. K. Reynolds, 136 Liberty Street, New York City, has the agency for this device, and reports that it is being adopted by a number of fixture houses.

Automatic Regulation of Temperature by Electricity.

The installation of the Compton magnet thermostat system in the Senate Chamber at the New Jersey State Capitol, Trenton, N. J., and adjoining rooms, has just been completed. The purpose of this system is to automatically open and close the valves on radiators and the large ventilators in the ceiling the moment the temperature becomes too cool or too warm. Peculiar-shaped appliances known as magnet thermostats are placed on the walls of the several rooms in about the same position the ordinary thermometer is hung to indicate the temperature.

These thermostats, however, instead of indicating the temperature, act as a harness to it and control the same without any personal attention.

The method of operation of these thermostats is as follows: A blade is rigidly fastened at one end inside of the guard cover, the other end being suspended between two small magnets. The blade is composed of two different metals, so riveted together that a slight rise in the temperature causes it to touch one of the magnets, while a fall in temperature of a single degree causes the blade to swing over and touch the other magnet. In either case an electric circuit is thereby closed. Concealed wires lead from these thermostats to small electric motors, which are located in the basement. These motors operate small valves, and these valves admit and discharge water through small pipes into diaphragms at each radiator valve; also into larger diaphragms, conveniently located, so as to operate the ventilators. Thus the street water pressure is in reality the power that operates the valves and ventilators.

Electricity controls the water supply, the thermostats control the electric motors, and the temperature controls the thermostats, and in turn

the combination of electricity and hydraulics regulate the temperature. The thermostat contains a scale with figures from "50" to "80." A pointer on the scale has only to be moved to the number of degrees at which it is desired that the temperature shall be maintained; the system by its automatic operation of valves and ventilators does the rest.

The successful operation by this system in the Senate Chamber will be a boon to the Senators as one and all agree that the temperature there has generally been at one extreme or the other.

Mr. Melvin D. Compton, of Newark, N. J., is the inventor of this system. He states that the system is in use in large office buildings and many private residences, and that he has received instructions from street railway companies and steam roads to equip some of their cars with it.

New English Electric Railway Systems.

The objections continually raised to the overhead trolley system in England and other parts, though not nearly so vigorous or extensive as formerly, has naturally made English and American electricians puzzle their brains and occupy their drawing offices with conduit and other proposals, having for their object the obviation of the necessity for trolley wires. With what measure of success their efforts have been crowned is ascertained from the progress that the trolley has continued to make in nearly every place where it has been introduced. While some experts are improving the trolley system and aiming at reducing the amount of overhead construction, others are busy endeavoring to discover an ideal and commercially successful accumulator, and yet others are occupying their inventive genius with experiments with conduit systems of easy and cheap construction. Two systems coming under this last class are shortly to be brought before British technical men.

One of these is the subject of numerous patents which have been taken out during a period of several years by one Esmond. This system of traction is being experimented with at Loughborough by the British Electric Traction Company, which company is busy all over England with electric railway schemes and is really pioneering such work in that country. The company contemplates the introduction of the Esmond system upon several lines for which it is securing Parlimentary powers. Complete details are not yet accessible, but the method appears to be the fixing along the track between the rails of a number of stationary contacts, each enclosing a magnetic switch to connect the contact with an underground supply conductor, current being taken from the contact to a bar attached to the car truck. There are various special points in the system.

The other method is the "Simplex" which is being exploited by the British Insulated Wire Company, Ltd., at Prescot. It has been devised by Mr. J. E. Waller, M. I. C. E., of London. An experimental line now laid down at Prescot, Lancashire, is one quarter of a mile in length, and a public demonstration is shortly to take place. The conductors are contained in a conduit beneath the road surface. In the place of one of the ordinary rails is substituted a double rail on the one side, between which a slot is left to admit of the electrical collector on the car making contact with the cable in the conduit. The conduit is fixed beneath, but slightly to the inside of the slotted rail, so that accidental contact is impossible. A flexible stranded conductor, or copper wire rope is used, and being flexible only requires to be supported at considerable intervals. Where supports are necessary, small side chambers are constructed to the conduit and covered over by removable lids which can only be raised by special keys. These hatchways give room for insulators, and the conductor lies on a bent iron bar about one fourth inch in diameter projecting from the under side of the insulator. On this bar the copper conductor is allowed to rest. The car is equipped with two hollow shanks, which travel in the slot of the slotted rail, and the shanks contain the insulated copper conductor. Attached to the lower end of these shanks, but insulated therefrom, is a gun-metal casting of horseshoe shape, in which the conductor lies. As the car proceeds along the line, the shoe rubs against the conductor, and the current is conveyed through the hollow shank, and thence by means of an insulated cable to the motors on the cars. The short length of railway referred to above has been so arranged at Prescot that in the quarter-mile length there are curves both easy and difficult, gradients, etc., so as to show the system running under the conditions met with in actual work.

Thermostats in Power-House Coal Pockets.

Recently there have been two notable instances of fire in coal pockets from spontaneous combustion—in the depot yards of the Boston & Maine Railroad Company at Boston, and the New York, New Haven & Hartford Railroad Company at New Haven—in both cases the loss sustained being quite considerable, to say nothing of the interruption to traffic and other property endangered. Fires from this cause have been entirely too frequent, and it is of interest to note that there has been aroused anew a desire to secure protection from such disasters.

The City & Suburban Street Railway Company, Baltimore, Md., has just made an important move in the direction of protection to its power-house coal pocket, and after most careful consideration of all the means of protection offered, it has finally settled upon the thermostat system of the Electric Heat Alarm Company, Boston. The system has already been applied most effectively by the United States Government in coal pockets on board ships, satisfactory results having also been secured from the use of this thermostat in connection with grain elevators, etc., and the coal pocket of the City & Suburban Company will be equipped with these thermostats somewhat after the same ideas, subject to the supervision and direction of Mr. P. O. Keilholtz, electrician of the City & Suburban Company.

This coal pocket is 200 feet long, 13 feet deep and 40 feet wide. It is proposed to have a row of four thermostats 3 feet 7 inches from the floor; also a row of three thermostats hanging down two feet from the top of each girder at the top of the coal pocket in each section. The thermostats will be connected by wire inside of the iron pipe to a 100-point detector in the power-house. Thus should a thermostat close in any part of the coal pocket, it will be known exactly where the temperature has reached the danger point. These thermostats are to be set at 160 degrees. Tests made at the detector board will show the condition of the system at any time, while actual tests will be made with an alcohol torch, the same as is done by the Government, as often as the thermostats can be easily reached.

Fig. 1 shows the thermostat in perspective; and Fig. 2 is a sectional view of the same.

The negative wire in Fig. 1 is attached to the pipe at the most convenient point. *N* is No. 16, heavily insulated wire, running through pipe to *O*; *P*, ¾ inch galvanized pipe; *O*, ordinary elbow; *N*, positive wire; *M*, binding screw for positive wire; *L*, pin to hold contact plunger in position; *I*, spiral spring inserted in fibre plug *F'* to ensure good electrical connection; *F'*, insulating plug inserted in ordinary elbow.

A is a steel needle in glass plug *B*. *D*, screw always immersed in chemically pure mercury, one pole to battery. *G*, Bessemer steel cup of thermostat. *F*, fibre plug of thermostat. *K*, chemically pure mercury filling steel cup. Should the temperature reach 160, the circuit will be closed through steel needle *A*, positive wire *N* to detector board, bell to battery through negative wire *R*. As soon as the attendant hears the bell ringing he starts a lever on the detector board. When the bell stops ringing he has come in contact with the number of the thermostat closed, for instance, No. 16, and it is known at once where spontaneous combustion has started. This enables the trouble to be remedied in a very few minutes. On board ship, the coal bunkers being in small pockets, live steam is immediately turned on, which of course quenches the fire; and in a short time the tests at the detector board

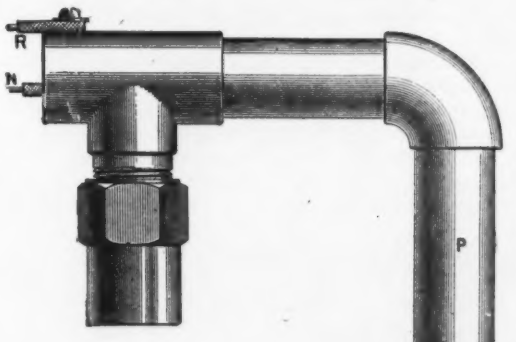


FIG. 1.

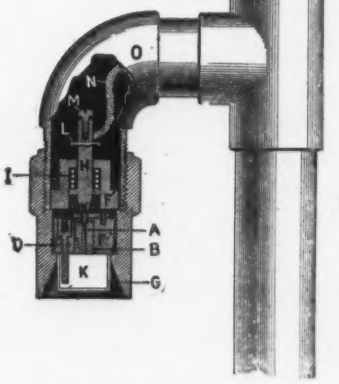


FIG. 2.

will show whether the fire has been subdued sufficiently to enable the thermostat to cool off. Should combustion "come on" again, the alarm will be sounded as before.

The adoption of this system by the City & Suburban Street Railway Company should mean similar recognition from other street railway companies and lighting and power plants generally.

This rheostat has the endorsement of fire underwriters generally. Lower rates of insurance are obtained on property where it is used, and this in itself is an important item and recommendation.

Storage Battery Plant and Electric Elevators for the New Waldorf Hotel, New York City.

In addition to the large dynamo installation, briefly described in The Electrical World of Jan. 9, the electric plant of this princely caravansary, when completed, will include the largest storage battery installation in this country. The Electric Storage Battery Company, Philadelphia, Pa., is to furnish this battery, which is to be made up of "chloride" plates 15 inches square, with a total capacity of 4000 ampere-hours at 120 volts, and will weigh approximately 90,000 pounds. Three booster dynamos will be used in connection with this battery plant. Two of these are to be motor-driven and one steam driven. The Western Electric Company, New York and Chicago, has the contract for these machines, as well as for the wiring of the building, which will be for about 13,000 incandescent lights. Iron-armored conduits will be used throughout. The adoption of electric elevators is quite in line with the other equipment. Twenty Sprague electric screw and drum elevators, embodying many clever new departures in elevator machinery, are to be supplied by the Sprague Electric Elevator Company, New York. A large number of ventilating and other motors, signaling and telephone appliances will also be installed, as well as other apparatus, tending to make this probably the largest and most complete isolated plant in the world.

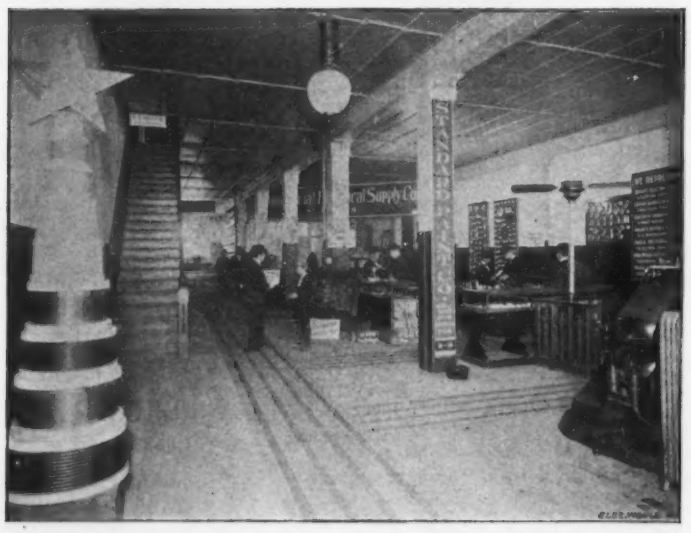
The Western Electric Company will also install the entire signaling system. This will include annunciators, watchman's clock, fire alarm and other auxiliary devices. The guest rooms will be connected with an annunciator central station on each floor. The absence of interior telephone or teleseme systems is notable.

An Enterprising Electrical House in St. Louis.

The Commercial Electrical Supply Company, 1007–1009 Market Street, St. Louis, Mo., commencing from a small beginning a few years ago, has attained the dignity of being classed among the most prominent business concerns in that city. Although its start was on a small scale, by the active energy and persistence of its managers it has grown to be one of the most prominent establishments in the trade in the entire West.

At the head of this worthy company stands out most prominently the figure of Mr. Joseph Franklin, Jr., to whom is largely due the successful career of the concern of which he is president. A few years ago Mr. Franklin started a small electrical supply house in connection with the old Commercial Company, at 821 Pine Street. He finally obtained control of the business, and bringing new capital into the concern, it was reorganized under the title of the Commercial Electrical Supply Company. Mr. Franklin then disposed of his interests in the street railway and electric light installation business to devote his entire time to the affairs of the reorganized company.

Under the new conditions the business soon outgrew its Pine Street quarters, and in order to provide better facilities for handling its rapidly increasing trade it was decided to procure a more commodious establishment. The building, 1007–9 Market Street, was finally secured, and it is



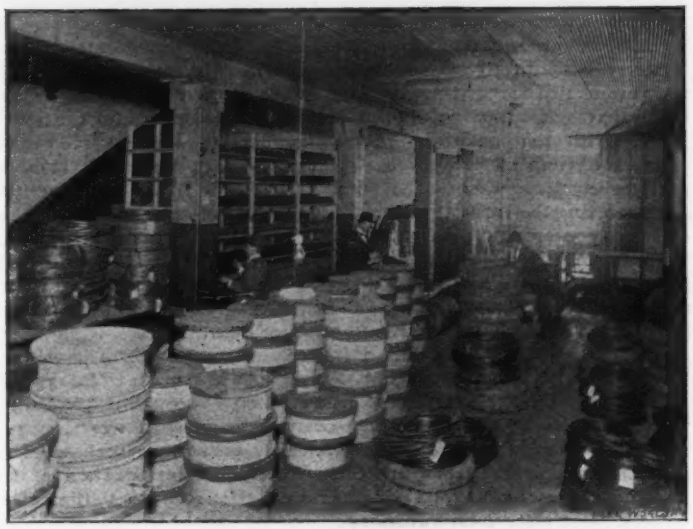
Show Room.

entirely occupied by the company. It has four floors and a cellar, all of which are filled with goods, with the exception of the space devoted to offices, and everywhere within the four walls is an air of business and activity.

The building is 127 feet deep and 35 feet wide, and at the rear is an alley which provides excellent facilities for the reception and shipment of goods.

In the cellar the large stock of heavy goods is kept. These include large wire, etc. On the main floor is located the salesroom. Here a great variety of wares is attractively displayed, with a view to enabling the purchaser to select what he desires with the best advantage possible. The walls are covered with sample boards containing the goods of the various concerns represented by the Commercial Company. Back of the salesroom is the retail or city department, and in the rear of that is the entry and shipping-room, where three elevators are available for the distribution and handling of goods to and between the various departments on the different floors. On the second floor is the counting-room and directors' room; also a large wareroom where is carried a large stock of smaller wires, conduits, etc. At the rear is the country packing and shipping-room. The third or top floor of the building is devoted entirely to stocks of general and small electrical supplies, of which the company carries a very large line.

Among the many concerns represented by the Commercial Electrical Supply Company may be mentioned the following: The India Rubber &



Stock Room.

Gutta Percha Insulating Company, New York, manufacturers of Habirshaw wires; Holmes, Booth & Haydens, New York; Pass & Seymour, Syracuse; Standard Paint Company, New York; Wagner Electric Manufacturing Company, St. Louis; Bryant Electric Company, Bridgeport, Conn., and Hugo Reisinger, New York.

The manager of this enterprising concern, Mr. Paul Dozier Cable, is one of the most progressive and aggressive young men in the electrical supply business. He has been engaged in the electrical trades for 20 years and is very popular. He makes it his business to keep in touch with the progress of the world, and is a very pleasant gentleman in every way. He started in the electrical field in the early days of telephony, and was prominently connected with that interest for some time. He is one of St. Louis' pioneer electrical men, and to his pluck and energy a large measure of the Commercial Electrical Supply Company's success is due.

The vice-president and treasurer of the company is Mr. Joseph Franklin, Sr., who is one of the foremost business men of St. Louis. He is prominently identified with numerous other prosperous concerns in the city and is foremost in St. Louis' financial circles.

The accompanying illustrations convey some idea of the magnitude of business carried on in this establishment. One of them gives a view of the stockroom, which is located on the second floor, and the other the showroom on the first floor.

Insulated Outlet Boxes.

The insulating qualities of interior conduit tubes have been regarded by some as exceedingly important, but no particular attention has been paid to the additional insulation of the conductor at the outlets where the tube usually terminates in an outlet box of suitable construction. It has been the practice to use a cast-iron box, the interior of which is coated with an ordinary baked enamel paint, which, aside from its lack of mechanical permanence, can hardly be regarded as a suitable insulation. If it is essential to provide the tube with a permanent insulating medium, it is equally if not more important to have the outlet boxes similarly arranged.

The Ward Leonard Company, Hoboken, N. J., fully cognizant of this fact, has recently acquired the sole rights on nearly all of the approved outlet boxes, switch boxes, junction boxes, floor boxes, cable boxes, drop cord boxes, receptacle boxes, etc., which have been known to the trade as the Mailloux, De Rycke, Krantz, Fountain and Soons boxes, and has materially improved them by coating the interior with a hard, vitreous porcelain enamel, similar to that used in its well-known Carpenter enamel rheostats. This insulating material will stand very hard usage, and is absolutely impervious to heat, moisture, acids, etc. Tests

with high voltages show that it is almost impossible to pierce this insulating lining. It is safe to say therefore that, with such superior insulating qualities and no increase in prices for the improved boxes, general approval may be expected.

Regulating Socket for Incandescent Lamps.

The accompanying illustration represents a regulating socket for incandescent lamps which is now ready to be put upon the market by Brunt & Thompson, East Liverpool, O.

These sockets are constructed for 110 volts, direct or alternating current, for use in connection with 16-cp lamps. They have been tested by the Chicago Edison Company and the Western Electric Company, both of whom, it is stated, claim that the socket effects a saving of 40 per cent. in current when turned down. The object of this socket is to permit of the light being turned down to a lower degree of brilliancy and is especially adapted, therefore, for use in the office, sick room, hotels, closets, vestibules, etc., etc. The light can be turned down from 16 candle-power to 2 candle-power in a manner similar to turning down a gas light.

REGULATING SOCKET.

Messrs. Brunt & Thompson are now testing a socket for the purpose of demonstrating the merits of this device as to durability. It has been in use for 300 hours turned down to two candle-power and is still at work. The firm claims that it has in this socket overcome all difficulties experienced in the use of other sockets of this class that have heretofore been presented for the favor of the trade and guarantees the device to do all that is claimed for it providing it is used in the manner directed.

Water-Power at Minneapolis.

The contract for the electrical utilization of the Falls of St. Anthony, at Minneapolis, has been awarded to the General Electric Company.

It will be remembered that the St. Anthony Water-Power Company and the Pillsbury flour mills and elevator lines were merged into the Pillsbury-Washburn Flour Mills Company, which controlled not only most of the developed water-power of the Falls, but also the undeveloped water power below the Falls. A dam to utilize this power was constructed and the total power available is calculated at 10,000 horse-power.

The water will pass through turbines of Stillwell-Bierce & Smith-Vaile manufacture, seven of which, each of 1000 horse-power capacity, will form the initial hydraulic equipment. The electrical equipment will consist of a plant comprising both direct-current railway apparatus for the needs of Minneapolis, and three-phase apparatus for transmission of part of the power to St. Paul, 10 miles distant.

The direct-current portion consists of two 700-kw General Electric multipolar generators, with a speed of 130 revolutions per minute, furnishing current at 600 volts, and two 100-kw exciters for the three-phase alternators.

The three-phase generating plant consists of five 700-kw alternators, with a frequency of 35 cycles and an initial voltage of 3450 volts. This pressure will be raised to 12,000 volts in six step-up transformers of the well-known air-blast type, and at this voltage the current will go to St. Paul either by overhead or underground wires, the method not yet having been decided upon. At St. Paul the pressure will be reduced in 15 step-down transformers, when the current will be led into the rotary converters of special type. Of these there will be five. They will resemble in appearance those which the General Electric Company has installed in the power-house of the Buffalo Street Railway Company to take care of the power transmitted from Niagara Falls. They are eight pole machines each of 600 kilowatts capacity, running at 520 revolutions and turning out direct current at 580 volts. They are designed to operate in parallel with each other, or with the generators now driven by steam in the existing station.

The water-power development and the electric plant completed by the Pillsbury-Washburn Company will be operated by the Twin City Rapid Transit Company a lease having been made between the two companies to that effect. The street car company will send to St. Paul about 3000 horse-power, leaving 4000 horse-power to be used at Minneapolis.

When the new power is set to work running the street cars, the street railway company will dismantle the Thirty-first Street power station, using the room for other purposes. The main power station at Third Avenue north and Second Street will be continued, and also the power station in St. Paul. These will be kept ready for emergencies, such as a break-down, a sudden call for extra power, and similar occasions. In case there is water enough and conditions are favorable, there are still three more units to be installed at the dam.

Large Independent Air Pump.

What is claimed to be the largest independent marine air pump in the world is shown in the accompanying illustration. This machine, which is constructed on the Blake "twin" system, was designed by the George F. Blake Manufacturing Company, New York City, for the new North German Lloyd Steamer *Kaiser Wilhelm der Grosse*, which was built and is being fitted out at the Vulcan Iron Works, Stettin, Germany.

It will be remembered that during the marine exhibition at Kiel the United States cruiser *New York* excited considerable interest among marine engineers and naval architects all over the world. Among the auxiliaries of this ship that were favorably commented upon were the independent air pumps of the Blake vertical "twin" system, and the Germans were so favorably impressed with these pumps that several of their cruisers have since been fitted out with them.

The pump under consideration, it will be seen from the illustration, is extremely compact and simple in design. It has two double-acting steam cylinders, 18 inches in diameter and two single-acting air cylinders, each 44 inches in diameter, the stroke being 24 inches. There are

INDEPENDENT AIR PUMP FOR STEAMER "KAISER WILHELM DER GROSSE."

two pumps of this size on the *Kaiser Wilhelm der Grosse* and they have a capacity at moderate speed sufficient to take care of the main engines when the latter develop 28,000 horse-power.

When these pumps were tested at the works of the George F. Blake Manufacturing Co. some months ago they formed a vacuum of 28¾ inches with temperatures of vapor and condensed steam at about 80 degrees Fahr., with the pumps working at a very moderate speed. The pumps were run up as high as 75 double strokes per minute, and operated as smoothly and quietly as they did at the rate of one double stroke per minute. Although they were not bolted to the floor they worked with-

out any vibration, showing that the working parts were well balanced and that the machine is perfectly self-contained.

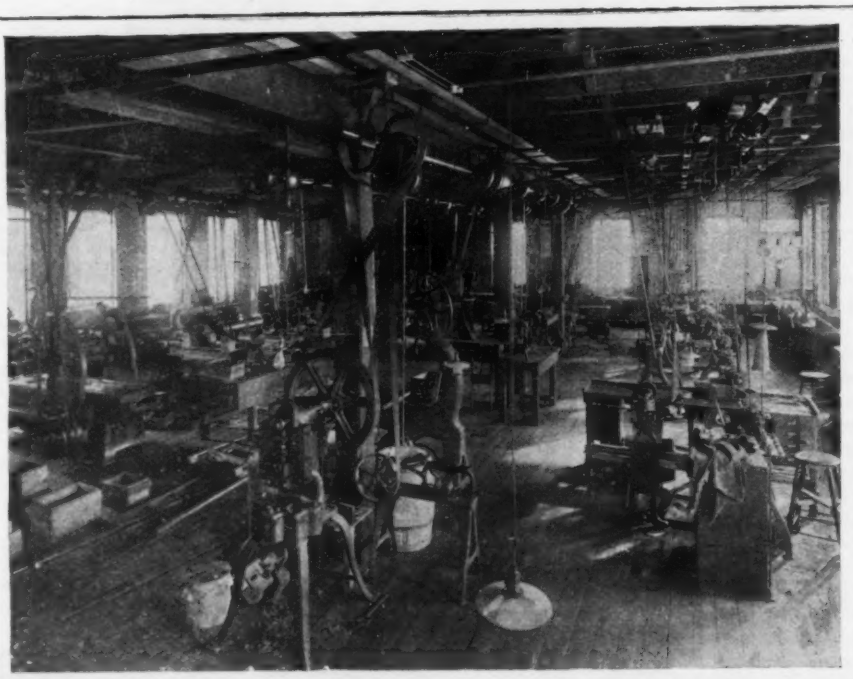
Although the Blake vertical "twin" system has shown an economy on the United States cruisers and battleships averaging about ⅛ of 1 per cent. of the I. H. P. of the main engines, it is fully expected that the big air pumps for the big North German Lloyd steamer will break the record in the matter of economy. It is calculated that they will not require less than $\frac{1}{10}$ of 1 per cent. of the I. H. P. of the main engine.

The Blake Company also fitted out the same steamer with an equipment of feed, fire and bilge pumps of its improved vertical type.

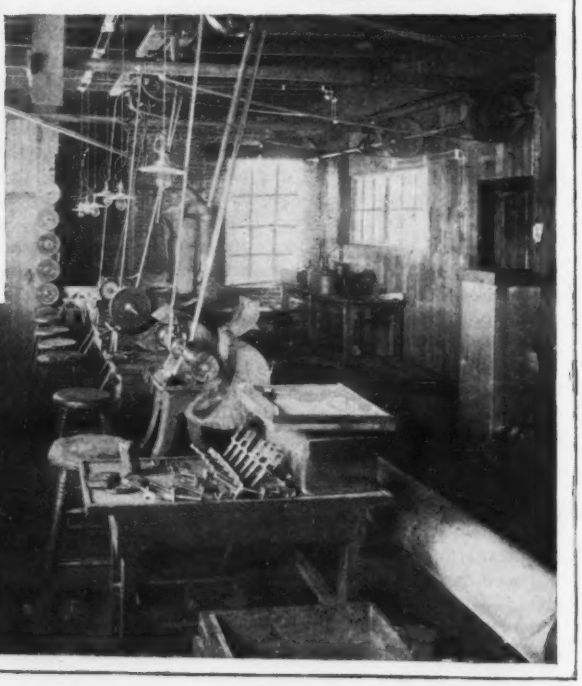
The W. S. Hill Electric Company's New Quarters.

The W. S. Hill Electric Company, manufacturer of switches and switchboards, and now located at New Bedford, Mass., possesses for the first time in its history a business home of its own, of which its stockholders and management feel justly proud. It affords ample room for the transaction of the company's already large manufacturing business, even anticipating increased demands. It is also an important and creditable addition to the manufacturing industries of the City of New Bedford, which, as is well known, are varied.

The building in which the company is located is a substantial structure three stories high, and covering a ground space of 50 x 80 feet, with additional space for extension should it become necessary. It is located in the business heart of the city on three of its principal streets—Water, Elm and Bethel. In the rear of the building is the engine and boiler room. The steam plant is a model one, and consists of a 100-hp Buckeye engine and a 150-hp boiler. The building is lighted by electricity, having a complete isolated plant of its own. The entire ground floor is used for stockrooms and shipping and receiving departments. On the second floor are situated the offices, machine shop, tool room, pattern room and draughting department. The third floor contains the polishing room, with its two adjacent rooms used for lacquering and finishing. On this floor are also located the assembling rooms, slate room, etc. In short, every detail in and about the building demonstrates wise forethought toward increasing the products and business of the company, quicker and better manufacture and prompt shipments. The plant, as a whole, is regarded as one of the largest, if indeed it is not the largest, used exclusively for the manufacture of electrical switches, and for the past nine months upward of 50 men have been steadily employed to meet the increasing demand for Hill switches. The two interior factory views, illustrated herewith, convey an idea of the manufacturing facilities of this new plant. The machinery room, as will be observed, is excellently equipped with the best and most improved machinery obtainable, and the polishing room is also admirably equipped. The company is talking of including a foundry, for which plans have already been drawn.



W. S. Hill Electric Co.—Machinery Room.



W. S. Hill Electric Co.—Polishing Room.

The switches and switchboards of the Hill Company have been liberally and universally recognized by the trade, and are to be seen in many notable installations. Until recently the switches of the company were of a strictly high grade and for high capacity, but in order to meet all demands of competition it is also placing on the market cheaper grades which will be known as its "all-copper switch," and based on the company's usual guarantee of 1000 amperes to each square inch of copper. These low-priced switches, it is claimed, will maintain the high standard of Hill goods and the finish is the same as in the high grades. They are made by new and improved machinery bought for this special purpose.

In addition to the regular lines of switches the company manufactures a large variety of special switches for all purposes, and a complete new line of fuse blocks at prices which will place the goods within the reach of all.

The company is just about issuing a handsome new catalogue which will show a list of nearly 4000 different styles and sizes of switches, and will present also a partial list of its recent important installations in some of the finest buildings.

The company is capitalized under the Massachusetts law at $70,000. Its original subscribed capital, under the new organization, was $60,000. The remaining $10,000 has only within the past few days been subscribed for, and the fact that the amount was taken by its stockholders is conclusive evidence of their satisfaction with the business which has already been done, as well as their confidence in the future of the company.

Lubricants for Electrical Machinery.

Few electrical engineers pay the attention to the subject of lubrication that its importance would seem to demand.

One of the essential qualities of a perfect lubricant for electrical machinery is that it shall adhere to the bearing surface where it is needed and not flow away from it.

A lubricating compound that is highly spoken of by those in the electrical business who have used it is manufactured in Milwaukee by the Kent Lubricant Company. Owing to its peculiar composition the Kent compound is said to adhere to the bearing surface, and to otherwise fulfill the requirement already mentioned. It is claimed that every particle of the compound is a lubricant, and that it is both homogeneous and stable. As it does not melt, there is no loss or waste, and it is said it will last longer than any lubricant affected by heat. Hence, indirectly it effects a saving of fuel, and avoids wear and tear on the journal bearings, thus prolonging their life.

The New York & New Jersey Lubricant Company, 30 Cortlandt Street, New York City, handles the Kent lubricating compound in this section, and the New England Lubricant Company, 103 Milk Street, Boston, looks after the trade in New England.

Among the prominent users of this compound in New York may be mentioned the Interior Conduit & Insulation Company, the De la Vergne Refrigerating Machinery Company, the Metropolitan Street Railway Company, *The New York Herald*, Harper & Brothers, the J. L. Mott Iron Works and others. It may be added as a matter of interest that all the journals on the great Ferris wheel at the Chicago World's Fair were very satisfactorily lubricated by the Kent compound.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 20, 1897.

ELECTRICAL STOCKS.—Since our last report there has been a stronger market in this class of securities, with the result that the closing quotations are all higher. Electric Storage Battery has advanced more than one point during the week, presumably on the strength of encouraging outlook for future business. General Electric, both common and preferred, is higher, while Westinghouse, which is the only exception to the general improvement, remains at unchanged quotations.

TELEGRAPHS AND TELEPHONES.—The general list is about steady in prices, the only exceptions being Bell Telephone and Western Union, both of which are higher. Bell stock closed at an advance of three points over the last quotation, and Western Union 1⅜ points better.

ELECTRIC TRACTIONS.—Nothing of moment is recorded in the market for these stocks, although there was a little more spirited activity for some shares, which resulted in advances. On a whole the market is about where it stood at the time of our last report. The Brooklyn stocks are unchanged. The railway bond market experienced advances in two instances. The market generally, however, is quiet.

ERIE TELEGRAPH & TELEPHONE COMPANY made a net gain of 2753 subscribers in December, and 2798 for the year 1896. Total number connected Jan. 1, 21,389.

DIVIDEND.—The Alpena (Mich.) Electric Light Company has declared its usual 2 per cent. dividend and added $500 to the sinking fund, besides retiring its regular yearly bonds.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	104	..
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	29¾	30
Electric Storage, pref	100	31¾	32
General Electric	100	34¼	34½
General Electric, pref	100	76	78
Westinghouse Consolidated, com	50	..	24
" " pref	50	50½	51½

BONDS.

Edison Electric Ill., New York	105	106⅜	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	90½	—

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	212	213
American District Telegraph	100	*29	39
American Telegraph & Cable	100	85	90
Central & South American Telegraph	100	124	127
Commercial Cables	100	160	172
Erie Telephone	100	64¾	65¼
New England Telephone	100	102	..
Postal Telegraph-Cable	100	91	94
Western Union Telegraph	100	84⅝	84⅞

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17¼	17½
Brooklyn Rapid Transit		18¾	19¼
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	74	77
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	39	42
Hestonville	100	50¼	50¾
" pref		..	62½
New Orleans Traction	100	..	11
" " pref	100	..	45
North Shore Traction	100	21	24
" " pref	100	72	78
Rochester St. Ry	..	..	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	64	64¾
" " pref	100	89	90
Worcester Traction	100	20	22
" " pref	100	95	98

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	78⅜	..
Buffalo St. Ry. 1st con. 5s	100	*107	110
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	94	96
Rochester St. Ry. 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge 5s		*101	104
*Westchester Electric 1st mtge 5s	500	100	103

* With accrued interest.

NEW STOCK ISSUE.—The Fairhaven & Westville Railroad Company, New Haven, Conn., has voted $300,000 of new stock to pay for the newly bought New Haven & Centreville Road.

ANNUAL REPORT.—The Edison Electric Illuminating Company, of Brooklyn, N.Y., in its report for the year ending Dec. 31 last, gives the following results; Gross earnings, $810,266, an increase of $189,117 as compared with the gross earnings during 1895; operating and general expenses, $451,266, an increase of $110,558; net earnings, $359,000, an increase of $78,558; balance, surplus, $59,412, increase $10,000. To provide for further enlargement of the company's facilities, made imperative by the increased demand for current for power as well as for lighting purposes, the management of the company is now raising an additional $500,000 through issue to the stockholders of record on Jan. 14, of $250,000 stock and $250,000 bonds. These additions to capital account will make the mortgage indebtedness, which is at 5 per cent., $1,250,000, with $4,000,000 stock.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Jan. 20, 1897.

THE BALL & WOOD CO., manufacturers of steam engines, will on Feb. 1 remove its New York offices from 15 Cortlandt Street to more modern and commodious quarters in the Beard Building, 120 Liberty Street.

THE NATIONAL UNDERGROUND CABLE COMPANY, New York City, on Jan. 19, filed with the Secretary of State at Albany, a certificate of increase of its capital stock from $200,000 to $500,000. The certificate is signed by Edward S. Perot, chairman, and James P. McQuaide, secretary of the meeting of stockholders. The company has a paid-in capital stock of $200,000, and debts and liabilities of $21,233.

"CITY GOVERNMENT," an interesting monthly magazine, published at 150 Nassau Street, this city, and devoted to the various branches of municipal government, is receiving many testimonials from city officials throughout the country. It is well edited and treats in a clear and interesting manner the questions it discusses. As the problem of municipal management is in many respects a huge business proposition, "City Government" has a wide field for usefulness in the matters upon which it treats.

POLICE TELEGRAPH.—Police Telegraph Superintendent Frank C. Mason, of Brooklyn, has submitted his annual report for 1896. There are in use at the present time 440 telephones and 353 patrol boxes, and 569 miles of wire, of which 350 are on poles and 219 attached to the elevated railway structure and underground. Mr. Mason strongly recommends that all the police wires be placed underground. Commissioner Wells and Superintendent McKelvey state that the work of the Telegraph Bureau in Brooklyn reflects credit upon Mr. Mason and his corps of operators.

THE FREEMAN CASE.—Walter K. Freeman, the electrical engineer who has for the past 11 months been in the Tombs awaiting a new trial on the complaint of Sarah E. Work on the charge of assault, was arraigned before Justice Smyth in the Criminal Branch of the Supreme Court on Jan. 20. This is Freeman's second trial for the same offence, being convicted at the first trial and sentenced to 10 years' imprisonment. A new trial was granted on the ground of the alleged discovery of new evidence. The new evidence bears on the age of the Work girl when the alleged offence was committed. The defendant asserts that it is a case of conspiracy against him.

MR. JOHN T. McROY, the manufacturer of terra cotta conduits, whose office is in the Chamber of Commerce Building, Chicago, has secured the contract for supplying the conduits to be put down by the Edison Illuminating Company, of Brooklyn, N. Y. The order will probably aggregate 260,000 feet of ducts. Mr. McRoy has been at the Hoffman House, New York, for a week or two, and will probably remain there for some weeks to come, until the Brooklyn work has been started. The Edison Company, it is understood, is to extend its lines as far as Coney Island, It now has five different powerhouses in Brooklyn, but it is to erect two more. Superintendent W. S Barstow has the placing of the contracts.

A FINE ISSUE.—The *Dry Goods Economist* of this city is to be complimented upon the handsome appearance of its Jubilee number, issued to commemorate its 50th anniversary. Not only is the Jubilee number a "thing of beauty," and therefore the incarnation of a joy forever, but its reading contents are of the most interesting and valuable character, covering the whole range of textile manufacture in every quarter of the globe. Mr. C. T. Root, the publisher, and his able and extensive staff of co-workers, have the hearty congratulations of THE ELECTRICAL WORLD for the continued and increasing success of the *Economist*, which deservedly stands in the foreground of technical or class journalism, not only in America but in the world.

MAGNETIC CLUB ELECTION.—The annual meeting of the Magnetic Club was held in the Western Union Telegraph Building on Jan. 14, at which the

following named gentlemen were elected officers for the ensuing year: President, E. H. Johnson; first vice-president, Thomas E. Fleming; second vice president, George H. Usher; third vice-president, R. J. Hutchinson; fourth vice-president, Walter C. Burton; secretary, Frank P. Murphy; treasurer, M. J. O'Leary. The next dinner of the club will be held at the Hotel Manhattan, corner of Madison Avenue and Forty-second Street, on the evening of Thursday, Feb. 4. A large attendance is expected and preparations are being made for a fine time. The new president, Mr. Johnson, is the president of the Interior Conduit & Insulation Company, New York.

THE ALEXANDER-CHAMBERLAIN ELECTRIC COMPANY, 56 West Twenty-second Street, New York, is commemorating the successful execution of the electrical engineering work in the immense new building of the Siegel-Cooper Company on Sixth Avenue by distributing to the trade souvenirs in the form of two heavy glass paper weights. On one is given an exterior view of the Siegel-Cooper Building, from the tall tower of which issue the rays of a powerful searchlight, and on the other is given a colored view of the electric fountain which forms a conspicuous feature of the interior of the building. This plant was designed and installed by the Alexander-Chamberlain Electric Company, and besides being one of the largest installations of its kind in the world, practically demonstrates the use of electricity for light, heat, power, ventilation and cooking on a larger scale than ever before attempted.

THE MARTIN ELECTRIC COMPANY, 22 Dey Street, New York City, (formerly Geo. L. Martin, 38 Cortlandt Street), has recently opened a general electrical repair shop at this address. It will make a specialty of dynamo and motor repairs of any nature, including armature and field rewinding, commutator work, etc., but is also in the field for the construction of new electrical appliances and experimental work. The plant comprises a large number of up-to-date tools for light and heavy work, and all work will be under the personal supervision of Mr. Martin, who for the past 15 years has been connected with various branches of electrical construction. The policy of the new concern will be to use only the highest class of labor and material, which in connection with its well equipped shop enables it to guarantee all work. The general wiring and construction business is also to be continued on an enlarged scale.

Buffalo and Niagara Falls Notes.

Buffalo, N. Y., Jan. 19, 1897.

CANADIAN POWER TUNNEL.—Attorney-Gen Hardy states emphatically that the Canadian Government has taken no action in the matter of four years' extension of time for the franchise of the Niagara Falls Power Company for building the Canadian power tunnel across the river.

BUFFALO ELECTRICAL AID ASSOCIATION.—The Buffalo Electrical Aid Association held its annual meeting and election of officers recently, at which meeting the following gentlemen were elected officers for 1897; President, Madison Buell (re-elected); vice-president, C. W. Burhans; treasurer, Wm. Walker.

LOCKPORT TELEPHONE FRANCHISE.—The Common Council of Lockport, N. Y., refused to renew the old franchise of the Bell Telephone Company, and has granted it the same franchise as was granted the Citizen's Mutual Telephone Company. The vote of the Alderman stood six and six and was decided in the affirmative by the Mayor.

BUFFALO-GARDENVILLE ELECTRIC LINE EXTENSION.—Chas. Schoepflin, president of the Buffalo, Gardenville & Ebenezer Electric Street Railway Company, has filed with the County Clerk a certificate for the extension of its lines. The company was organized in May, 1884, and the present road runs from Seneca Street, Buffalo, north and east to the village of Gardenville, and south to the village of Ebenezer.

NEW NIAGARA FALLS ELECTRIC RAILWAY COMPANY.—Mayor Schoelkopf, of Niagara Falls, announced a special order of business for a hearing in the matter of the application of the Niagara Falls Electric Railway Company for a franchise to lay tracks on Niagara and other streets of the city. At the request of Attorney S. J. Laurence of the Railway Company the hearing was adjourned until the first Monday in February.

PRESIDENT-ELECT McKINLEY STARTS A TRAIN BY ELECTRICITY.—President-elect McKinley pressed a button in his library in Canton, O., transmitting thereby a current of electricity through a Western Union wire, which opened the throttle-valve of Erie engine No. 1058. This started the largest salt train ever run, consisting of 161 cars loaded with salt from the Worcester Salt Company, Silver Springs. The total weight of salt was 5,000,000 pounds, consisting of over 14,000 barrels and over 10,000 sacks.

BUFFALO & NIAGARA FALLS ELECTRIC RAILWAY DEFAULTER.—Chas. M. Burlingame, the electric railway defaulter, was arraigned before Justice Parker on the charge of grand larceny in the first degree, the complaint being made by Manager Burt Van Horn, of the Buffalo & Niagara Falls Electric Railway Company. He waived examination and was held to await the action of the Grand Jury, which will sit in February. Mr. Burlingame was auditor of the electric road and misappropriated over $1000.

BUFFALO'S NEW TELEPHONE COMPANY.—Mr. Edward Koens states that the company is a national company and has machines in 23 towns and cities and may soon ask the telephone users of Buffalo to give it a trial. Among the other men interested in the new company are Tracy C. Becker, Edward Michaels, Henry Kerns and Geo. Urban, Jr. The parent company—the Strowger Company—is located in Chicago, and the company, of which Mr. Edward Michaels is president, owns the State rights for New York and Pennsylvania.

NEW ELECTRIC LINE BETWEEN PENN YAN AND BRANCHPORT.—The committee having in charge the new electric road between Penn Yan and Branchport state that it is expected work will begin in early Spring, and that cars will be running in time for the session of the Keuka Assembly next August. The road will be constructed with 70-pound rails, and of standard gauge. The steam plant will be located at Penn Yan, and consist of 100-hp engines and generators. The stock will be non-assessable, and will be at par value $100 per share.

NIAGARA ELECTRIC POWER FOR LOCKPORT, N. Y.—Superintendent Forestall of the company now furnishing the electric lights for the City of Lockport, N. Y., published a statement regarding the rumor that the company has secured the first right to electricity transmitted from Niagara power. He does not deny the story and gives the public to understand that since the company has been losing money at furnishing arc lights at $72, it has no notion of entering into another contract to supply them at that price.

REPORTED FAILURE OF NIAGARA POWER PLANT.—The publication that the Niagara Power Company's plant was forced to close down because of anchor ice was considerably exaggerated. Investigation proves that the difficulty was not serious or other than temporary. The trouble was caused from the fact that the company began to change its ice racks, and during the change anchor ice interfered with the operation of the plant. The Aluminum plant of the Pittsburg Reduction Company and the Carborundum plant and the Carbide plant were shut down for a short time. No serious trouble resulted and at no time was the plant entirely shut down.

NIAGARA POWER DISTRICT EXTENSIONS.—The plant of the Mathieson Alkali Company is to make a big showing. The brick walls are up one story and indicate that the plant is to be a very large one. On the other side of the Junction Railway work is in progress on the foundations of the plant of the Albert Wilson Chemical Company, which is also to be a large one. As already noted, the Pittsburg Reduction Company has materially added to its force. The Carbide Manufacturing Company has just signed contracts with the Niagara Falls Power Company for 4000 horse-power additional. The company has been at work for some time constructing additions to its plant, and it has been known that it would require more power and more men, but the contract for the power has now been signed.

ALUMINUM FOR AN AIR SHIP.—The Pittsburg Reduction Company has sold the Atlantic & Pacific Aërial Navigation Company a quantity of aluminum to be used in the construction of an air ship on a large scale. The company has been formed and 86,400 shares have been absorbed by the incorporators, all of whom are men of wealth. Ten thousand shares have been sold in the open market in San Francisco. Working models of the air ship are in the rooms of the company in the Spreckels Building, San Francisco. The complete vessel will be 200 feet long over all and the cylinder will be 35 feet in diameter by 125 feet, the cones tapering to a point at a distance of about 50 feet each from the cylinder. The propelling power will be a Maxim engine of 180 horse-power, weighing complete 340 pounds. Superintendent Dickey, of the Pittsburg Reduction Company, said that his company had sold the air ship company a quantity of aluminum and had received pay for the same, but that was all he knew about the enterprise.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., Jan. 19, 1897.

MR. F. S. TERRY, of the Sunbeam Lamp Manufacturing Company, Chicago, was in Boston recently making arrangements to establish an agency in that city for the "Sunbeam Lamp."

THE INTERNATIONAL ELECTRIC COMPANY, St. Louis, Mo., manufacturers of the "Davey" incandescent lamp, is doing a brisk business, and in anticipation of still further increasing the volume thereof is putting in a number of new double pumps and generally getting its plant ready for a larger output.

H. C. PAYNE AND THE CABINET.—Mr. James E. Keelyn, president of the Western Telephone Construction Company, is circulating literature and a petition bearing on the proposition to urge the appointment of Mr. H. C. Payne, of Milwaukee, to the position of Postmaster-General in the new Cabinet. Mr. Keelyn is endeavoring to defeat the appointment on the ground that Mr. Payne represents the interests of the Bell Telephone Company.

MR. BURT HUBBELL, secretary of the Keystone Telephone Company, of Pittsburg, Pa., has been in the West for a week or two, attending telephone conventions in that section and visiting customers and prospective customers of the Keystone Company. Mr. Hubbell is one of the best-known men in the "outside" telephone business, and his company has made an excellent reputation for itself, both in the quality of its instruments and also in the satisfactory manner in which it looks after its customers.

THE ADVANCE ELECTRIC COMPANY, successor of the late firm of MacCurdy & Smith, is situated at the old stand, 94 and 96 N. Meridian Street, Indianapolis, Ind. It is an incorporated stock company, and its officers are: D. D. Smith, president; Harry B. Marsh, secretary and engineer; Charles H. Talmage, treasurer. This company has just put in a select stock of goods and is prepared to do a wholesale, retail and construction business. Mr. Smith, of the late firm, has been retained in the management of the new.

THE RUPRECHT ELECTRIC COMPANY, Cleveland, O., made a fine exhibition of its Röntgen-ray apparatus at the entertainment given by the "Cleveland Grays," the city's crack company of State militia, at its armory, on Jan. 18, last. The Röntgen-ray apparatus consisted of the usual low and high-frequency transformers and Crookes tube in active operation. The Ruprecht Company, which is located at 236 Superior Street, is busily engaged in answering the demands made upon it by the medical fraternity of Cleveland.

MR. WM. C. MACCURDY, of the late firm of MacCurdy & Smith, Indianapolis, Ind., which was dissolved on Dec. 19, last, has opened an office as manufacturers's agent and consulting engineer, in the Baldwin Building in that city. Mr. Mac Curdy reports having already closed contracts with a number of prominent firms for the sale of their goods in his territory, and has several more contracts pending. Having a wide acquaintance in the trade and high-grade goods to sell, Mr. Mac Curdy's prospects for future business are excellent,

THE BRYAN-MARSH COMPANY, New York, in order to more properly supply its Western and Central Western trade, has established a distributing depot in Chicago and opened a handsome suite of offices at 1239-1240 Monadnock Building. A stock of 100,000 lamps will be kept on hand at all times for the prompt supply of urgent demands. A large wareroom has also been secured.

A new feature will be a customers' room, which the out-of-town trade will be cordially invited to make use of when in the city. The leading trade journals and daily papers will be kept on file and a stenographer will take care of all correspondence.

MILWAUKEE CONVENTION NOTES.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, was represented by its vice-president, F. S. Terry, and its treasurer, A. S. Terry.

MR. J. M HILL, formerly of the Columbia Incandescent Lamp Company, who has recently been appointed Western manager of the Bryan-Marsh Company, was present and as active as usual.

THE PEOPLE'S ELECTRIC COMPANY, Madison, Wis., was represented by L. W. Burch, managing partner. Mr. Burch is well and favorably known all over Wisconsin, and so is the People's Electric Company.

SARGENT & LUNDY, Chicago, were ably represented by Mr. Julian Roe, who did much good work in pushing the sale of the Crocker-Wheeler Electric Company's dynamos and motors, of which Sargent & Lundy have the Western agency.

THE FORT WAYNE ELECTRIC CORPORATION'S interests were well served by Mr. William J. Buckley, who was kept busy answering questions regarding his company's direct current and alternating incandescent lighting apparatus.

THE BADGER ELECTRIC COMPANY, Racine, Wis, was represented by Mr. P. H. Korst, who moved about among the delegates putting in many good words for his company's products, and winning hosts of friends by his genial and pleasant manner.

MR. C. E. GREGORY, of Chicago, without whose presence an electrical convention would seem strange, was as full of good stories as usual. Mr. Gregory carries his own sunshine with him, and that is probably one reason for his unquestioned popularity.

THE CHICAGO GENERAL FIXTURE COMPANY, Chicago, was represented by L. D. Kittman. This company is one of the largest and most important in its line in the entire country and its success is due to the distinctive merits of its goods.

MR. JAMES P. MALIA, well known as the chief electrician of Armour & Co., paid a short visit to the convention. Mr. Malia was on his way West, but managed to stop over long enough to spend an hour or two with his many friends on the convention floor.

THE DEARBORN DRUG & CHEMICAL WORKS, Chicago, had an exceedingly agreeable representative in Mr. S. E. Christe, who answered all inquiries in so thorough and satisfactory a manner as to demonstrate his wide practical knowledge of the business.

THE ELECTRICAL EXCHANGE, Chicago, was represented by Mr. T. Selby Lane, one of the most gentlemanly hustlers in the business. Mr Lane is considered a perfect wonder, and all who know him are pleased to find that his efforts are meeting with such marked success.

MR. A. C. BUNCE, of Chicago, was there, and as usual, his presence was quickly demonstrated. He was as noisy and good natured as ever, and was continually surrounded by a large circle of friends, to whom he related many interesting electrical experiences, that were keenly appreciated.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, was represented by Mr. W. C. McKinlock, who talked filter from start to finish. The Metropolitan Company has recently secured a number of important new agencies, and is doing an excellent business in its various departments.

GEORGE CUTTER, of Chicago, was on hand and in exceedingly good spirits. He looked well; said he was enjoying good health, and that business with him was excellent. He was to be seen here, there and everywhere among the little knots of conversers, and usually the central figure.

THE LAKON TRANSFORMER was kept well to the front by Mr. F. S. Terry, the Chicago manager of the Lakon Company, Elkhart, Ind. These transformers are meeting with more and more success every year, and the interest taken in them by the delegates was highly gratifying to Mr. Terry.

THE NEW YORK INSULATED WIRE COMPANY'S interests were looked out for by Mr. James Wolff, well known to all the trade as one of the greatest hustlers in the electrical business. That Mr Wolff is popular in the West was unmistakably demonstrated by the hearty welcome he received at the convention.

THE CARD ELECTRIC MOTOR & DYNAMO COMPANY, Cincinnati, O., and the Automatic Circuit Breaker Company, Newaygo, Mich., were both represented by Mr. A. Shillinglaw, of Chicago. Mr. Shillinglaw is a delightful gentleman, and took great interest in the convention. He reported the companies he represented to be meeting with good business, and looked for a prosperous year.

THE WASHINGTON CARBON COMPANY, Pittsburg, Pa., had two representatives, Mr. J. S. Crider, the secretary of the company, and Mr. D. G. McDougall, its Chicago agent, both of whom endeavored in every way to make the convention attractive and instructive, as well as a highly enjoyable electrical gathering.

THE LESCHEN-MACOMBER-WHYTE COMPANY, Chicago, were represented by Mr. Geo. S. Whyte, the genial secretary of the company, who, in addition to his other qualifications, is an excellent musician. Mr. Whyte was a very busy man at the convention, shaking hands with old acquaintances and making many new ones.

THE WESTINGHOUSE GLASS COMPANY, through Messrs. Donley and Bounce, of Chicago, made a handsome display of its leading specialties, and also exhibited two direct-current 100-hour arc lamps; one alternating-current arc lamp, and one Scheeffer wattmeter, in addition to an exhibit of Sawyer-Man incandescent lamps.

MR. WILLARD W. LOW was one of the leading spirits of the convention. What the boys irreverently referred to as the Low, melodious voice was heard ringing through the corridors of the hotel at all hours, and his after-dinner address at the banquet brought forth thunders of applause. Mr. Low is held in high esteem by all who know him.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY, Philadelphia, Pa, exhibited its well-known I-T-E circuit-breaker, which attracted much attention, especially after the paper on "Safety Devices" had been read by Prof. Stine. The interests of the Cutter Company were in charge of its Western manager, F. S. Terry, and its special sales agent, J. H. McGill.

THE GRAPHITE RHEOSTAT COMPANY, Chicago, was represented by Mr. W. D. Mahoney. This company had one of the most interesting exhibits at the convention. It was the new type of Wheatstone bridge, lately put on the market by Mr. M. A. Knapp. For convenience and accuracy, even irrespective of its low price, this instrument appeals very strongly to station men.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., had an attractive exhibit which was in charge of Mr. M. C. Wheaton, the company's genial and popular manager. Mr. Wheaton's enterprising business methods and executive ability are resulting in the building up a large business for his company, which is rapidly taking a leading position among the independent telephone companies.

MR. CARYL D. HASKINS supplemented his convention paper on "Röntgen Rays" by exhibiting to the association a very complete collection of lantern slides made from radiographs taken by various experimenters throughout the country. He also brought with him for exhibition purposes a set of Röntgen-ray apparatus as manufactured by the General Electric Company, the methods of operating which were thoroughly described.

THE AMERICAN ELECTRIC HEATING CORPORATION, Boston, Mass., had an exhibit that attracted much attention. It embraced a five o'clock tea kettle, a new chafing dish, disc heater and switch immersion coil, and an aluminum stew pan. Besides these, there were pan cake griddles, sad irons, goose irons, electric heating pads and an automatic curling iron heater. The display was in charge of Mr. F. P. Luther, the company's Western manager, whose office is in the Monadnock Block, Chicago.

MR. J. P. WILLIAMS, of New York, has been in Chicago for the past week, attending to the placing of an agency for the sale of the Paragon fan motors. The Chicago Edison Company, after a thorough test of the Paragon, has taken the exclusive agency for Cook County, Ill., and has placed a large order with Mr. Williams, who also reports numerous other advance sales of the Paragon all through the South and West. Mr. Williams feels confident of excellent business for his fan motors this coming season.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY is to be complimented upon its splendid exhibit, which consisted of two 25,000-watt central-station converters; two 4-kw central-station converters and high-tension fuse blocks; one 5-hp two-phase Tesla motor: one Shallenberger two-phase wattmeter; one 100 volt three-lamp economy coil and two 300-board high-tension fuse blocks. This fine exhibit was in charge of Messrs. E. Dyer, W. S. Rugg and Henry Floy, who showed it to great advantage.

MR. W. GRAY, of the Chicago office, represented the Peckham Motor Truck & Wheel Company, New York, and distributed many of the handsome souvenir memorandum books of his company. Mr. Gray is a regular hustler, and was one of the busiest men present. He is a comparatively new man in the electrical business, but promises to be one of the most successful in his line, especially as he has the benefit of the valuable assistance of Mr J. A. Hanna, manager of the Western office of the Peckham Company.

THE CHARLES E. GREGORY COMPANY, Chicago, under the management of Mr. A. Louis Kuehmsted, is inviting special attention to the repair department of the company, which it feels proud of as the leading establishment of the kind in the West. This company is well known as headquarters for electrical machinery that has seen some service, all of which it carefully puts in order before offering for sale. The reputation of the house is a guarantee of the thorough work it does on the apparatus it supplies.

THE COLUMBIA INCANDESCENT LAMP COMPANY had as its representative at the convention Mr. A. C. Garrison, the secretary of the company. Mr. Garrison has been in the lamp business for many years and is well known in the trade and made many friends at the convention. The company exhibited a full line of 220-volt and special series-burning railway lamps, also fancy and decorative lamps. A special feature of the display which attracted much attention and interest was the material from which the filaments are made, showing the different stages in the course of preparation.

MR. FRANKLIN S. TERRY, of Chicago, is one of the best-known and most highly esteemed gentlemen connected with the electrical business, and a convention without him would be incomplete. Mr. Terry is a pioneer in this field, having been engaged in the electrical business since 1880, at the very beginning of commercial electric lighting. He is interested in a number of electrical enterprises, being vice-president of the Sunbeam Incandescent Lamp Company, Western manager for the Cutter Electrical & Manufacturing Company, Philadelphia, and manager of the Chicago office of the Lakon Company, Elkhart, Ind.

THE GENERAL ELECTRIC COMPANY was represented by B. E. Sunny, George K. Wheeler and Percy A. Clisdell, Chicago; C. D. Haskins, Boston; H. C. Wirt, Schenectady, N. Y., and Thomas Ferris, Milwaukee. The exhibit of the company was in Parlor No. 8, near the Convention Hall. Among other things were shown samples of the new Wirt alternating-current short-gap lightning arresters, together with the company's new three-ampere and five-ampere long-burning arc-lamps, type H. as well as transformer and Thomson inclined-coil instruments. The apparatus manufactured by the General Electric Company for generating Röntgen rays, as shown by Mr. Haskins, was the hit of the convention and elicited universally favorable comment. Messrs. Sunny, Wirt, Ferris, Clisdell and Wheeler were thoroughly in evidence throughout the meeting. The great advantage of oil as an insulator was brought out very clearly by the fact that the very high potentials produced in the Röntgen-ray apparatus of the General Electric Company were handled with absolute safety.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, was represented by Sales Manager E. H. Abadie, and made quite an elaborate

display. On a large table were exhibited a number of high potential switches with carbon breaks. Central station men were also interested in the type D Wagner transformer, the lid of which being removed exposed to view the coils and iron core, and also permitted an examination of the manner of changing connections on a porcelain block, which is arranged in all the Wagner transformers with interchangeable primaries. With this device either one or two thousand volts can be used. That which seemed to attract the most attention in the Wagner exhibit, however, was a single-phase alternating current ceiling fan motor. This motor is designed for a current of 7,200 alternations per minute, and operates on the usual secondaries of 100 or 50 volts. It has ball bearings submerged in a cup of oil sufficient to lubricate the motor for two years' operation on an average of 18 hours a day. The blades are attached directly to the revolving field and can be set at any angle desired. The switching device, which is placed slightly above the revolving field, is unique. It is operated by a handle in the form of a kettle, which is the oil-cup for the bearing referred to. The motor is started by turning the kettle to the right. A wattmeter was inserted to show to those interested the current required to operate the fan. At 110 volts the meter registered 120 watts, and at 115 volts the index showed 130 watts. It is claimed to be impossible to burn these motors out, and they are guaranteed to operate perfectly with ordinary care for a period of one year. They can be adapted to any height of ceiling. The Wagner Company also exhibited for the first time its fuse-box, type XL, which called forth many compliments. The readiness with which a fused plug may be put in place of a blown one was appreciatively commented upon, while the spring quick-break baby knife-switch was considered an excellent example of its class, not alone for the advantage of quick break but also for the fine mechanical construction and finish that characterizes the work turned out by the Wagner Company. A handsome souvenir, consisting of an ink-well in the shape of a transformer, was distributed to the central station men present. It is said that the Wagner Company secured some very flattering orders at the convention.

General News.

New Incorporations.

THE BENTON HARBOR ELECTRIC RAILWAY & TRANSIT COMPANY has been incorporated at Benton Harbor, Mich., with a capital stock of $650,000.

THE COLORADO ELECTRIC POWER COMPANY, Colorado Springs, Col., has been organized by D. V. Donaldson, J. A. Hayes and George B. Buckman.

THE GARFIELD ELECTRIC LIGHT COMPANY, Chicago, Ill., has been incorporated with a capital stock of $25,000. The incorporators are W. K. Amerson, Louis Schaubel and M. Wengler.

THE BELFAST TELEPHONE COMPANY, Belfast, N. Y., has been formed with a capital stock of $1000. Those interested are J. H. Chamberlain, N. C. Saunders, O. Gleason, of Belfast, and others.

THE NEW CASTLE TRACTION COMPANY, New Castle, Pa., has been incorporated with a capital stock of $500,000. The directors are E. L. Allen, Allegheny; W. L. Merwin and H. W. Mitchell, Pittsburg.

THE ELECTRIC PORTABLE LAMP COMPANY, Gloucester, Mass., has been incorporated with a capital stock of $50,000. The incorporators are John R. Williams, Merchantville; J. F. Sinnott, Jr., and Carl H. Reed, of Philadelphia.

THE FALLSBURG & MONTICELLO RAILROAD COMPANY has been incorporated to build five miles of railway. Capital stock $75,000. The incorporators are B. Van Steenburg, 53 Broadway, New York, C. B. Harris, Lester Rock and others.

THE NEW YORK & STATEN ISLAND ELECTRIC COMPANY, of Castleton, S. I., N. Y., has been incorporated by John B. Summerfield and De Witt V. D. Bailey, of Brooklyn; Samuel B Lawrence, Francis P. Lowery and Charles L. Horton, of New York City. The company is capitalized at $500,000.

Telegraph and Telephone.

CANTON, ILL.—The Astoria Telephone Company will extend its lines to Cuba and Canton.

CADILLAC, MICH.—The Grand Rapids Telephone Company is considering plans with a view to extending its line to Cadillac and other northern Michigan town.

MARINETTE, WIS.—The Northwestern Telephone & Electric Company, Milwaukee, is planning the erection of a toll line from Marinette to Marquette, including intermediate points. The company, it is stated, has been operating successfully exchanges at Oshkosh and Sheboygan, and will commence work on the Marquette line immediately.

FORT DODGE, IA.—Alline Brothers, State agents for the Gamewell Fire Alarm Telegraph Company, are putting in an equipment at Mason City, Ia., the work to be completed about Feb. 10. The line will be about five miles in length and consist of hard-drawn copper insulated wire. The system includes six non-interference boxes, three electro-mechanical gongs and a tower bell striker.

Electric Light and Power.

GREELEY, COL.—The City Council has under discussion the establishment of a municipal lighting plant.

FAIRMONT, MINN.—The city electric light plant was destroyed by fire recently, entailing a loss of about $3000.

NEWARK, N. J.—Samuel Kalisch, lawyer, will erect a fine residence at 988 Broad Street, which will be lighted throughout by electricity

PARIS, MO.—At the last meeting of the City Council it was decided to submit an electric light proposition to the voters at the April election.

CHARLOTTE, MICH.—The proposition to bond the town for $15,000 to erect an electric light plant will be voted on at the next meeting of the Council.

UPPER SANDUSKY, O.—The Citizens' Electric Light & Power Company will enlarge its plant for the accommodation of an incandescent service, for which there is a large demand.

TREMONT, PA.—Tremont wants to run its own electric light plant, and the taxpayers are going to vote on the question of increasing the debt for the purpose of buying the plant now in use.

REYNOLDSVILLE, PA.—The Reynoldsville Electric, Light, Heat & Power Company has been granted permission to establish an electric light plant and to use the streets and alleys to erect poles.

TRENTON, N. J.—A certificate of dissolution has been filed with the Secretary of State by the Town of Union Heisler Electric Light Company, which was organized to furnish electric light to Hoboken.

CUMBERLAND, MD.—The City Council has passed an ordinance for the erection of an electric light plant by the municipality at a cost of $20,000. The ordinance will be submitted to the vote of the people.

ALBANY, N. Y.—The Paul Boynton Company expects to expend $150,000 in improving Pleasure Island. An electric plant will be erected, and over 200 electric lights will be distributed throughout the place.

AUGUSTA, ME.—A bill has been introduced in the Legislature to authorize the United Gas & Electric Company, which is a New Hampshire corporation, to hold property and transact business in the State of Maine.

ALPENA, MICH.—Superintendent Couse, of the Alpena Electric Light Company, has installed an isolated plant of 80 lights for the Huron Handle & Lumber Company, making the seventh plant of this character in this city.

RALEIGH, N. C.—The special committee of the Board of Alderman to take into consideration the purchase of an electric light plant for the city, has held a meeting. The present contract for lighting the city expires May 1 next.

LEHIGHTON, PA.—At the coming election the taxpayers of this place will vote on the question of increasing the indebtedness of the borough $22,000 for the purpose of establishing an electric light plant to be owned and controlled by the borough.

JACKSON, MISS.—Weathers & Weathers, of Memphis, Tenn., have prepared plans for the new State Capitol Building to be erected. The building will be equipped with electric elevators and lighted throughout by electricity. L. N. Weathers will superintend the construction of the building.

PORTLAND, ME.—A bill to repeal the corporation monopoly law has been introduced into the Maine Legislature. This law prevents any person or corporation from furnishing gas or electricity for light and power in any city or town in the State where an individual or corporation is already located. This virtually gives the existing individual or corporation a monopoly.

TORONTO, ONT.—Fire in the station of the Toronto Electric Light Company, early on the morning of Jan. 21, caused heavy damage to the dynamos and deprived the streets of electric light on the night following. Business interests depending upon the electric power were also affected by the destruction of the electric machinery. The loss is stated to be $150,000 and is fully covered by insurance. New machinery has been ordered from Chicago, Cleveland and Montreal to be forwarded by special trains.

The Electric Railway.

FLORENCE, ALA.—The City Council has granted A. P. Harland and associates a franchise for a street railway from the Union Depot to Court Street.

PARKERSBURG, W. VA.—Z. T. Yarrow, C. M. Darby and Wm. Caskey are seeking the privilege of using the Williamstown and Parkersburg turnpikes to build an electric railway connecting the two places.

PENN YAN, N. Y.—Ex-State Senator Theodore C. Bates, William H. Tylee, Charles W. Houch and Willis Rugg, all of Worcester, Mass., are interested in a project to build an electric road from Penn Yan to Branchport, N. Y.

WESTFIELD, N. J.—Chandler W. Riker is president of the company incorporated to operate a trolley line to run from the Central Railroad station in Elizabeth to Westfield. Capital, $200,000. It is understood that B. M. Shanley, of Newark, and John D. Crimmins, are also interested.

SAVANNAH, GA.—The electric railway has been purchased by Herman Myers for $211,000. The company will be reorganized with a capital stock of $500,000, and it proposes to engage in the lighting business as well as operate the street railway. A new plant on the river front will be erected

LONG ISLAND CITY, N. Y.—The Queens County Board of Supervisors at a meeting held on Jan. 12, resolved to sell out the franchise of the Long Island electric road for the construction of a trolley line between Jamaica and Hempstead, this action of the Board being taken because of the failure of the company to comply with the terms of the franchise as regards the time in which the road should have been completed. About one half of the road has already been constructed.

PORTLAND, ME.—At the present session of the State Legislature a special charter will be asked for to construct an electric railway from Westbrook to Waterford, a distance of 30 miles. The road will extend through the towns of Gorham, Windham, Raymond, Casco, Naples, Harrison and Waterford, and will open up a large farming and lumber district as well as some of the finest summer resorts to be found in the State. State Senator Charles M. Waterhouse and Judge J. H. Tolman, of Westbrook, Me., are interested.

SAVANNAH, GA.—The Electric Railway Company will be succeeded by the Savannah Traction Company, which has just applied for a charter, with a capital stock of $500,000. The chief feature of interest in the new company's

charter is that it asks for the privilege of doing an electric lighting as well as a street railway business The company proposes to erect a large plant somewhere on the river front which will furnish all the power necessary to operate the street railway and do a general lighting business. The lighting service will be conducted in opposition to that of the Brush Electric Company. The receivers of the Electric Railway Company have been discharged by the court.

PERSONAL NOTES.

MR. CHARLES E. GREGORY, manager of the Elliptical Carbon Company, Chicago, was in New York last week on a business trip.

PROF. S. H. SHORT, second vice-president of the Walker Company, Cleveland, O., was in the city during the past week on a short business trip.

MR. JOSEPH M. HILL, whose features are shown herewith, is one of the best known lamp men in Chicago, and his numerous friends will be pleased to learn of his new connection, as Western manager of the interests of the Bryan-Marsh Company, New York. Mr. Hill has for the past three years been acting in the capacity of Chicago manager for the Columbia Incandescent Lamp Company, St. Louis, Mo. He is well known throughout the West, and his advocacy of an article always attests its merit. Mr. Hill's friends will wish him much success in his present venture, and the Bryan-Marsh Company may well be congratulated on its good fortune in securing the services of one so eminent in his line as Mr. Hill.

J. M. HILL.

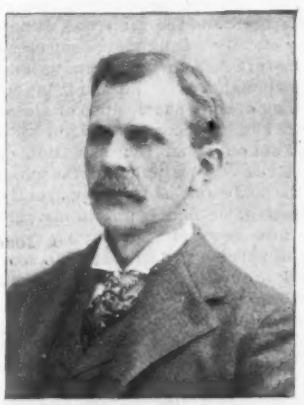
MR. FREDERIC SHERMAN BURKE, manager of the Crown Woven Wire Brush Company, Salem, Mass., was, on January 14, united in marriage to Miss Bessie Orne Ryder, daughter of Mr. and Mrs. J Orne Ryder. Mr. Ryder is secretary and treasurer of the Crown Woven Wire Brush Company The church in which the ceremony took place was handsomely decorated with flowers. Guests were present from Boston, New York and Providence. The many friends of the bride and groom wish them a long and happy life.

MR. J. F. CUMMINGS, president of the Armorite Conduit Company, Detroit, Mich., has arrived in this city after a flying trip to Pittsburg, Washington, Philadelphia and Boston. He reports a large demand for Armorite, and that his factory is busy night and day filling large orders. He also reports closing contracts for conduit for the large new Hotel Henry, Pittsburg.

MR. J. G. IHMSEN, manager of the Keystone Telephone Company, Pittsburg, Pa. was in New York during the week on business. Mr. Ihmsen is making a trip through the Eastern States. He reports increasing sales and a most promising outlook for the Keystone 'phone. Those who meet Mr Ihmsen will be as much pleased with his charming personality as they will with the excellence of the Keystone telephones, and that is saying considerable.

MR. E. WARD WILKINS, a member of the firm of Partrick & Carter Company, Philadelphia, the well-known manufacturers of electrical house goods and general supplies, has started on an extensive Western trip. Mr. Wilkins will stop at many of the principal cities between Chicago and San Francisco, and those upon whom he calls will meet one of the pleasantest and at the same time one of the most representative gentlemen in the electrical manufacturing or supply business.

MR. CHARLES S. MENDELL, president and general manager of the W. S. Hill Electric Company, New Bedford, Mass., is in the 35th year of his age, 17 of which have been actively spent in the different departments of electrical work. During this time he acquired varied and all-round practical experience and knowledge, particularly of details of manufacture, of inestimable value to him in his present important executive position. Mr. Mendell was born in Mattapoisett, Mass.; graduated creditably from high school, and at 17 years of age became a clerk in a store at New Bedford. He entered the service of Mr. Hill in Boston when he was 18 and remained with him about six years. In May, 1888, he accepted a position with the Standard Electric Company, St. Johnsbury, Vt., and was prominently identified with its dynamo manufactures. In September, 1890, he became connected with the Economic Electric Company, Brockton, Mass., as superintendent of its incandescent lamp manufactures. In September, 1892, he was appointed electrician of the Union Street Railway Company, New Bedford, and had complete supervision of changing this company's system from animal power to electrical power, and the building of its new power station and car houses. In January, 1896 when the Beckley syndicate obtained control of the road, Mr. Mendell tendered his resignation. Shortly thereafter, the W. S. Hill Company having encountered misfortune and a syndicate of New Bedford capitalists having become favorably impressed with the business, Mr. Mendell was induced to assume the control and management of the concern, becoming a stockholder in its new organization and removing the business from Boston to New Bedford. Mr. Mendell is one of the few younger men in the electrical business who have made headway and prominence from the bottom round of the ladder. Socially Mr. Mendell is a most pleasant gentlemen, and his personal characteristics have made for him a large circle of friends who wish and predict for him the fullest measure of success.



C. S. MENDELL.

LEGAL NOTES.

ELECTRIC LIGHTING NOT A MANUFACTURING INDUSTRY.—The Maryland Court of Appeals has affirmed the decree of the Circuit Court of Frederick County, which holds that an electric light plant is not a manufacturing industry, but rather an agency for the distribution of something already in existence, and therefore is not privileged to the exception from taxation voted by the Aldermen of Frederick to manufacturing establishments.

TROLLEY DECISION.—At Pittsburg, on Jan. 14, in the suit of the Thomson-Houston Electric Company against the Johnson Company and several other concerns, Judge Acheson, in the United States Circuit Court, decided that the claim of an infringment is valid against three of the defendants, the Johnson Company, the Steel Motor Company and R. T. Lane. The suit was based on an alleged infringement of improvements in traveling contacts for electric railways.

IN FAVOR OF THE WESTERN UNION.—On Jan. 15 the Appellate Division of the Supreme Court, in New York City, rendered a decision in the case of Curtin *vs.* the Western Union Telegraph Company, in which the Court holds that there can be no recovery on account of mental distress occasioned by the failure to properly transmit and deliver a telegram. In this particular case there was a delay of four days in the delivery of a despatch announcing the death of the plaintiff's brother, and she was in consequence unable to attend his funeral. The plaintiff, Maggie Curtin, of New York City, sued the Western Union Telegraph Company for damages, alleging that her grief made her ill. She obtained judgment in the City Court for $125. This judgment was carried to the Appellate Division of the Supreme Court, which has now been reversed. In the Appellate Division only one question was considered, and that was whether there could be a recovery for mental distress causing physical illness.

Trade and Industrial Notes.

THE CLONBROCK STEAM BOILER COMPANY, Brooklyn, N. Y., has issued an exceedingly handsome catalogue, a copy of which the company will take pleasure in sending upon application.

THE PURITAN ELECTRIC COMPANY, 173 Devonshire Street, Boston, has issued a monthly calendar for 1897 on which is printed a reproduction of a well-known painting representing a phase of Puritan life.

WILLIAMS, COUCH & WHITMAN, 196 Summer Street, Boston, Mass., sole selling agents for the U. S. of the well known Swedish telephones of L. M. Ericsson & Co., dissolved partnership on Jan. 20, 1897, and the business of the firm will hereafter be carried on by Messrs. Whitman & Couch.

W. R. FLEMING & CO., 203 Broadway, New York, Eastern representatives for the Harrisburg Foundry & Machine Company manufacturer of the well-known Ideal engines, are presenting the trade with a neat monthly calendar. Illustrations of various types of engines are shown.

THE NEW YORK ACCUMULATOR & ELECTRIC COMPANY, 150 Nassau Street, New York, has issued a set of four catalogues describing its portable accumulators, portable electric lanterns, portable dental accumulators and family medical and surgical batteries. The devices are well illustrated and their useful application clearly set forth. A price-list of the same and other data of interest are given.

MR. EDWARD J. WESSELS, president of the Moore Electrical Company, Newark, N. J., says that his company is making excellent progress with its vacuum tube lighting. He adds that work is so far advanced that during this year the company expects to place a portion of its system on the market. In the Moore laboratory incandescent lamps have been abandoned and the rooms are now lighted wholly with Mr. Moore's vacuum tubes.

MR. L. E. FRORUP, New York, general sales agent for the Schiff-Jordan Company, carbon manufacturers, has started on an extended Western trip in the interest of his company. Mr. Frorup is in possession of several letters from important buyers requesting an interview, therefore he anticipates a very successful trip. Mr Straschenow, the general manager, is very much gratified over the rapidly-increasing reputation of the Schiff-Jordan carbons.

THE WALKER COMPANY, Cleveland, O., has issued a circular on "'Independent' Manufacturers of Electric Railway Apparatus and Electrical Machinery for Power and Lighting." In it the company claims that it is destined to be the only "independent" manufacturer of street railway and electrical apparatus. The circular is very fully illustrated, and describes concisely the various apparatus manufactured by this company, showing up their points of merit in considerable detail.

THE ELECTRIC APPLIANCE COMPANY Chicago, Ill., tells a rather amusing story of the enthusiasm of the contractor over his first job with Armorite conduit. It certainly is a pleasure to a contractor to be able to draw the wire into the tube without the use of soapstone and other lubricants which are usually necessary. The lining of the Armorite tube offers almost no resistance to the passage of the wire, and the wire certainly does slip through the conduit with remarkable ease.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has secured the general Western agency for the Alcatraz electrical compound. Those unacquainted with the Alcatraz compound will find by a trial that it gives splendid satisfaction. It will not scale, crack or burn; adheres tenaciously, and is proof against the action of the elements. The compound is made from the celebrated Alcatraz asphalt, and is claimed to possess many points of superiority over other similar compounds now on the market.

THE NATIONAL METER COMPANY, whose factory is at Forty-second Street and First Avenue, South Brooklyn, N. Y., is looking for improved electric sparking devices to be used in its Nash gas engines. At present an

ordinary battery and spark coil with a make-and-break contact inside of the engine cylinder is used, but the company wishes to adopt some better method. An induction coil and jumping spark arrangement, or some method using a small magneto in place of batteries, if sufficiently cheap and efficient will be generally adopted.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N.J., has issued two pamphlets on the subject of its silica graphite paint One pamphlet deals entirely with the nature, manufacture and uses of the paint, while the other contains a few testimonial letters from some of those using the same. The silica graphite paint has a record of over 25 years, and it is stated that roofs well painted with it have not required repainting in 15 to 20 years. It is recommended for metal and woodwork, roofs, bridges, telegraph and trolley poles, smoke stacks, boiler fronts and iron construction work of buildings.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Ia., is not only doing good business at home, but is receiving orders from sister republics. Among its Winter orders is one from an electric light station in the capital of old Mexico, which is the fourth it has received from the same concern at intervals of about nine months. This the Garton-Daniels Electric Company interprets to mean that the Mexico station finds the Garton lighting arresters more serviceable and reliable than any other. The last order was for twice as many as ordered at any previous time, and for station use on 110-volt direct current circuits.

NEW APPARATUS FOR NIAGARA POWER.—The directors of the Niagara Falls Power Company have authorized the officers to enter into contracts with the I P. Morris Company, Philadelphia, for the construction of five 5000-hp turbines, and with the Westinghouse Electric & Manufacturing Company, Pittsburg, for five 5000-hp dynamos—the turbines and dynamos to be practically the same as those now in use. William Sellers & Co., Philadelphia, will also be given a contract for the manufacture of five turbine governors and five sluice gates. It is stated that these contracts will amount to over $500,000.

THE W. D. GRAVES ELECTRICAL & MACHINE WORKS, Cleveland, O., has just finished what is claimed to be the largest and costliest switchboard ever made. The board, now being installed in the new power-house of the Chicago City Railway, Chicago, is 98 feet 8 inches in length and 16 feet high. It is equipped for 12 2000-ampere dynamos, and 54 feeder-circuits of 1000 amperes each. Each dynamo is provided with wattmeter, Cutter circuit-breaker and Weston ammeter. The bus-bars are built up with laminated copper, thus allowing for additions. The body is polished slate, and trimmed with Italian marble. All seams, both horizontal and vertical, are covered with metal moulding finished in nickel.

THE C & C ELECTRIC COMPANY, 143 Liberty Street, New York, has recently installed one of its 4-P dynamo and Case engine combination on the ferryboat *City of Englewood*, of the New York & Fort Lee ferry. The C & C Company furnishes these combinations in capacities ranging from 1½ kilowatts to 12 kilowatts. These combinations are well adapted for small isolated lighting plants, such as steamer and house lighting, and wherever space and weight are important factors. Standard flange couplings connect the dynamo to the engine, the entire combination being securely bolted to a sub-base. Perfect alignment is thus ensured while at the same time this arrangement facilitates the repairing of both the engine and dynamo; in fact they are absolutely independent of each other.

JAS. C. WORMLEY & CO., Chicago, report their lamp-testing apparatus to be meeting with great favor. The simplicity and accuracy of the little device is rapidly making it popular. With this apparatus, the danger of lamp factories mixing their barrels with lamps of different efficiencies (contrary to orders) is entirely done away with. The smallest fraction of a watt difference is shown so distinctly that a lamp of low efficiency may be picked out immediately. Mr. Wormley says his house is again in a position to fill orders promptly. He also reports that their 10 per cent. cut in incandescent lamps for the month of January has greatly increased their business and that many large central stations as well as the isolated plants, both East and West, are taking advantage of it. Carrying a stock in the East, as well as in Chicago, enables them to make prompt shipments at low freight rates.

THE WILLIAMS & ABBOTT ELECTRIC COMPANY and the Kirk-Latty Manufacturing Company, both of Cleveland, O., have consolidated and hereafter the latter, the Kirk-Latty Manufacturing Company, will be the sole manufacturer of the magneto bells, telephone receivers, etc., up to this time made by the Williams & Abbott Company. The Kirk-Latty Manufacturing Company will manufacture a full and complete line of magneto bells, switchboards, telephone receivers, telephone supplies, together with other electrical and mechanical devices. The company is building a new and large factory and equipping it with the most modern machinery and appliances, and will have facilities for turning out these goods in large quantities and of even an improved quality. All communications for prices, etc , are to be addressed to the Kirk-Latty Manufacturing Company, Electrical Department, Cleveland, O.

MR. I. P. FRINK, manufacturer of light reflectors at 551 Pearl Street, New York, seems to have solved the problem of store window lighting. The trouble has always been that the lamps were either scattered at the bottom or along the sides of the window, where they were seen by the lookers-in and attracted more attention than the goods themselves. To overcome this objection, Mr. Frink has invented what he terms his "special window reflector." It is a long, narrow reflector lined with silver-plated corrugated glass, and placed in the top of the window, near the front glass, reflecting the light inward and downward. It is an ideal window light in every respect. It lights the goods perfectly and yet cannot itself be seen. Mr. Frink has placed the reflector in many windows, substituting it for the old method, and in each instance the storekeepers were amazed that a window could be so satisfactorily illuminated at so little expense.

THE CENTRAL MANUFACTURING COMPANY, Chattanooga, Tenn., is one of the oldest concerns in the business of manufacturing and dealing in cross-arms, insulator pins and brackets for electric line construction, and the magnitude of its trade in this one branch of its vast business attests the reputation of the company Among the notable contracts filled by the company may be mentioned that for the cross-arms and pins for the Buffalo-Niagara Falls power transmission line. These cross-arms are made of the heart of long-leaf yellow pine, and are said to be the finest lot of cross-arms ever turned out for any pole line. The company carries a large stock of its products on hand at all times, and is thereby enabled to give favorable quotations on shipments of any magnitude to any part of the United States. The company makes a specialty of yellow pine cross-arms, locust pins, oak pins, oak brackets and moulding for electrical construction

THE NEW YORK ELECTRIC EQUIPMENT COMPANY, Thirty-third Street and First Avenue, New York City, appears to be getting a large percentage of recent installation work in this city and vicinity. Among the large buildings which are being or have been equipped by it during the last year the following may be mentioned: New York Life Insurance Company Building, Leonard Street and Broadway, New York City; New York Stock Exchange Building, Johnston Building, Broad Street and Exchange Place, New York City; St. Paul Building, Broadway and Ann Street, New York City; American Lithograph Company Building, New York City; Bradford Mercantile Building, 21 Washington Place, New York City; Munsey Building, New London, Conn; Taunton Post Office Building, Taunton, Mass., and a large number of smaller structures. The new Bergman steel-armored insulating tube has been used in most instances for all smaller tube work. As the company manufacture this tube as well as all panel and switchboards used in these installations it is enabled to produce superior results.

THE ELECTRIC ENGINEERING & SUPPLY COMPANY, of Syracuse, N. Y, has one of the most systematically arranged manufacturing plants in the country. On a recent visit THE ELECTRICAL WORLD representative was impressed with the businesslike and shipshape condition of every department of the establishment from basement to attic. There can be no question of the importance as well as of the economy of having a place for everything and everything in its place, and this the Electric Engineering & Supply Company has. Mr. Herbert A. May, who has been connected with the company for many years, first as bookkeeper and latterly as cashier, seems to have a large bump of order, and both he and the company are to be congratulated on the admirable results they have achieved. The company manufactures all the parts that enter into its switches, switchboards and numerous other specialties, and can therefore guarantee everything it offers for sale. A thorough inspection of each particular piece which leaves the establishment ensures that nothing will be sent out that is not perfect. Mr F. M. Hawkins, the New York agent of the Electric Engineering & Supply Company, whose office is in the Thames Building, alone furnishes enough orders to keep a good-sized factory busy.

THE BALL ENGINE COMPANY, Erie, Pa., reports the following shipments during the last 30 days: Shoenberger Steel Company, Pittsburg, Pa., one 150-hp vertical direct connected; one 400-hp vertical direct connected; Chicago Public Library, Chicago, Ill., four 200-hp vertical cross compound; one 100-hp vertical cross compound. Nicopol-Mariopol Mining & Metallurgical Company, Mariopol, Russia, one 400-hp vertical cross compound, direct connected; to Mexico, five 25-hp engines. Jackson Street Railway Company, Jackson, Tenn., two 175-hp engines Electric Installation Company, Geneva; Ill., one 100-hp engine; one 70-hp engine. Hammond Building, Detroit, Mich., two 70-hp engines, direct connected. United Coke & Gas Co., Glassport, Pa., one 60-hp engine. Paul C. Stensland Building, Chicago, one 125-hp engine, direct connected. Crook, Horner & Co., Baltimore, Md., one 50-hp engine, direct connected. Church Home and Infirmary, Baltimore, Md., one 60-hp direct connected engine. Pine Ridge Indian Reservation, one 35-hp engine, direct connected. Rosebud Indian Reservation, one 35-hp engine, direct connected. Pennsylvania Tube Works, Pittsburg, Pa., one 60 hp engine. Junaluski Leather Company, Waynesville, N C., one 50-hp engine. Wauwatosa County Insane Asylum, Wauwatosa, Wis., one 70-hp engine; one 110-hp engine. A M Fuller Building, Chicago, one 70-hp engine.

MICANITE.—As an evidence of the worth of micanite insulation, the following letter, received by the Mica Insulator Company, New York, from the Schenectady Railway Company, will be read with interest:

Dec. 21, 1896.

Mica Insulator Company, Charles W. Jefferson, Manager.

DEAR SIR:—In March, 1894, you put a full body and slot insulation of Micanite on one of our Edison No. 16 street-car armatures, and the same was wound at once and put in service and has been pretty steadily running ever since, the car having made over 50,000 miles. The armature has never given us any trouble in "body-grounds" since it started, although it is of the "ring" type, and is not protected by the motor frame, it being open to snow, slush or water from the wheels. The wiring on this armature has just been burned out by a severe and continued overload, so heavy as to not only char the insulation of the wire, but to melt some of the wires themselves. On stripping off the wires we were surprised to find the insulation of the body and slots in apparently good order; and after fully stripping and testing, we find it absolutely perfect, mechanically and electrically, and are now rewinding it, having done nothing to the insulation but to give it a coat of varnish and bake it. We consider this so remarkable a record that we think it only justice to you to inform you of it. While the full Micanite body insulation costs several times more than our previous method of cloth, mica and paper, the results in freedom from armature "body-grounds," and the ability to reuse the insulation indefinitely, are points that will make us consider the use of Micanite as essential in all our work for the future. Very truly yours,

SCHENECTADY RAILWAY COMPANY,
Per H. S. Cooper, Supt.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company. 67–71 Park Place, New York City.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 12, 1897.
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

574,885. CONTROLLER FOR ELECTRIC MOTORS; H. P. Davis, Pittsburg, Pa. App. filed Dec. 3, 1895. In a controller for electric motors, the combination with circumferentially-arranged sets of stationary contact block or pieces, and a centrally-mounted head movable a limited distance from neutral position in either direction, and having radial arms provided with contacts at their outer ends, electrically connected in pairs of a plurality of resistance, each permanently connected to two sets of contact blocks.

574,889. ELECTRIC CIGAR LIGHTER; J. W. Dawson, Louisville, Ky. App. filed Aug. 17, 1895. In a cigar lighter and advertising device, the combination of a handle, a wire filament, a weighted pivoted cross-bar, a switch, a lamp, and a cigar-cutting apparatus connected to said weighted cross-bar in such a manner that when the handle is being drawn in position to light the cigar, the lamp and the cigar-lighting device are connected in circuit and the cutter is operated, the parts so constructed that they are returned to their normal position by the weights on said weighted pivoted cross-bar.

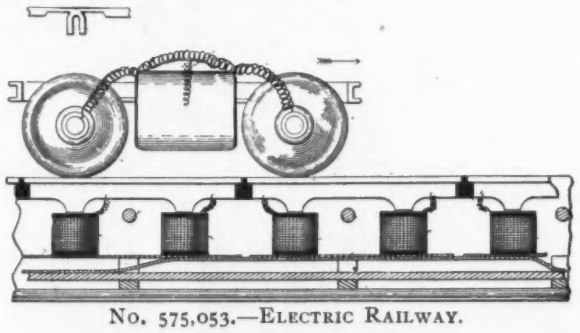
574,896. COMBINED RHEOSTAT AND REVERSING SWITCH; J. P. B. Fiske and C. P. Smith, Alliance, O. App. filed March 18, 1895. The combination with the casing composed of two substantially similar halves or sections and provided with openings for the escape of heated air, of a resistance contained within the casing, a reversing switch secured to the face of one half or section of the casing and a resistance switch secured to the face of the other.

574,901. TELEPHONE; C. C. Gould, Philadelphia, Pa. App. filed April 29, 1895. In a telephone the combination with a diaphragm, of a basket comprising a series of arms and having the form of a conic or pyramidic frustrum, and a rolling electrode mounted in said basket and adapted to collide with said diaphragm and partake of rectilinear motion between said arms.

574,903. ELECTRIC METER; J. Hessberger, Niedersedlitz, Germany. App. filed Aug. 10, 1895. An electrical measuring instrument comprising a bismuth or bismuth-alloy conductor arranged in circuit, and a second conductor in circuit and producing a magnetic field, one of said conductors being movable in relation to the other.

574,905. ELECTRIC ARC LAMP; R. O. Hood, Danvers, Mass. App. filed July 6, 1896. In an arc lamp the combination of a mass whose expansion under the action of the electric current separates the carbons employed therein and a magnet in series with the arc for feeding the carbons toward each other when the current flowing across the arc is at a predetermined value.

574,907. GAS FIXTURE; E. A. C. Kaysel, New York, N. Y. App. filed June 24, 1896. In a fixture, the combination with a gas and electrical connection, of a pipe-arm having two adjacent parallel ways therein, one a gas way and the other a conduit for wires, said conduit being above the gas-way at the main pipe connection, a gas-cock having two ways therein corresponding and registering with the ways of said pipe-arm, and a plug in said gas-cock extending into the gas-way only.



No. 575,053.—ELECTRIC RAILWAY.

574,914. MEANS FOR ADJUSTING COMPOUND-WOUND DYNAMOS; B. G. Lamme, Pittsburg, Pa. App. filed Dec. 28, 1893. Two or more compound-wound dynamos working in parallel, and an equalizing or compensating wire connecting them; in combination with means for shunting more or less current around more or less of the series field-magnet coils of one or more of said dynamos, and a variable resistance in series with one or more of said series-field magnet coils.

574,922. ELECTRIC CALENDAR CLOCK; G. W. MacKenzie, Beaver, Pa App. filed Dec 28, 1895. In a secondary clock in combination with an intermittently electrically actuated minute wheel mounted on a shaft, carrying a minute hand, an hour wheel intermittently actuated by a pawl attached to the minute wheel mounted on a hollow sleeve surrounding the minute-wheel shaft and carrying the hour hand, and a month wheel intermittently actuated by a pawl attached to the hour wheel mounted on a hollow sleeve surrounding the hour-hand sleeve, and carrying the day-of-month hand; a regulator wheel provided on the inside with ratchet teeth designed to be engaged by the intermittently actuated hooked pawl pivotally attached to the month wheel and designed to bear against a fixed pin at one period of its revolution, the regulator wheel bearing on its face the names of the months in rotation and having pockets in its periphery of varying depths.

574,926. OVERHEAD ELECTRICAL KNIFE SWITCH; J. Menchen, Kansas City, Mo. App. filed Feb. 25, 1896. An overhead switch comprising an insulating base, standards depending vertically therefrom, an insulating reciprocatory cross-head mounted thereon, knife terminal jaws secured to the base, contact-knives carried by said cross-head, and provided with pivotal terminals, and retractile springs connected with each pair of pivotal terminals.

574,953. ELECTRICAL SIGNAL SYSTEM; R. Skeen, Madison, Ill. App. filed March 4, 1895. A system comprising an electrical railway provided with a trolley wire for supplying current thereto, having an insulated section, a switch for cutting off the current from said section, and a railway crossing the former road, the one end of the insulated section terminating substantially at the crossing road and a live wire over the electrical road in addition to the insulated section.

574,954. ELECTRIC SIGNAL; R. Skeen, Madison, Ill. App. filed May 11, 1895. The combination with the crossing-tracks and an electric conductor extending along one track for supplying electricity as a motive power, of means under the control of a train moving along the other track for temporarily cutting the electricity off from a portion of the said conductor along the first-named track, and a locking device to lock said means throughout the duration of said temporary cut-out.

574,978. SYSTEM OF LIGHTNING PROTECTION FOR ELECTRIC CIRCUITS; A. J. Wurts, Pittsburg, Pa. App. filed July 19, 1893. In a system of electrical distribution, the combination with a source of current and translating devices, of a line circuit provided at suitable intervals with underground inductive resistances serving to dissipate static charges by transforming their energy into heat.

574,979. DEVICE FOR PROTECTING ELECTRIC CIRCUITS; A. J. Wurts, Pittsburg, Pa. App. filed Oct. 2, 1895. The combination with a lightning arrester having a ground connection, of a choke coil and a conducting strip extending along said coil for a portion of its length, whereby spark gaps are formed between the same and the adjacent turns of the coil, and an electrical connection between said strip and the lightning arrester.

574,994. PRINTING TELEGRAPH; B. Hoffman, Paris, France. App filed July 17, 1895. In a printing telegraph the following defined improvements, namely, the combination of a type-wheel and escapement connected together, an escapement magnet controlling said escapement, a printing magnet adapted to act on the stopping of the escapement, a local battery and circuit operating said magnets, a polarized relay controlling said local circuit, a line-circuit, means for sending intermittent currents of normal direction over said circuit, and a pole-changer for reversing said currents at will.

575,002. ILLUMINANT FOR INCANDESCENT LAMPS; A. De Lodyguine Pittsburg, Pa. App. filed Jan. 4, 1893. An incandescent filament for electric lamps composed of an incandescing metallic body and containing a conducting fillit of different material.

575,025. REPEATER; W. M. Chapman, Needham, Mass. App. filed Dec. 12, 1895. In a repeater, the combination of two or more circuits, each having a controller, independent operating devices for the repeater corresponding in number to the number of circuits, and operated respectively by the said controllers, a repeating circuit-closer for each circuit, and independent detachable supports attached to the main frame of the repeater, each bearing one of the operating devices, and also one of the repeating circuit-closers.

575,045. ELECTRIC VALVE APPARATUS; J. V. Stout, Easton, Pa. App. filed June 7, 1892. In a valve controlling device, the combination with the valve, of a frame carrying two magnets and two armature-levers, the armature-lever of one of the magnets controlling the valve and provided with a contact controlling the circuit of the second magnet only, the armature-lever of the second magnet operating as a lock for the armature-lever of the first magnet and provided with a contact controlling the circuit of the first magnet only, one of said contacts being made when the other is broken whereby but one magnet can be energized at the closing of the circuit.

575,047. ELECTRIC QUICK-BREAK SWITCH; A. H. Armen, Philadelphia, Pa. App. filed March 30, 1896. In an electric quick-break switch, the combination of a switch-lever and push-button working in planes perpendicular to each other, with a button arm auxiliary to the button, and a spring working between the switch lever and button-arm.

575,053. ELECTRIC RAILWAY; L. Dion, Natick, Mass. App. filed Dec. 30, 1895. In an electric railway the combination of the following instrumentalities, *viz.*, a closed conduit along the line of track, a series of insulated contact-plates forming the top of said conduit, an electric motor and car or wheeled vehicle, a contact-carriage connected with said car or vehicle and adapted to travel on the contact-plates, main and auxiliary electrical conductors within said conduit and a series of electromagnets within said conduit located between the electrical conductors and the contact plates and arranged in a manner to establish an electric circuit between the main electric conductor and the electric motor as the car is propelled along the line.

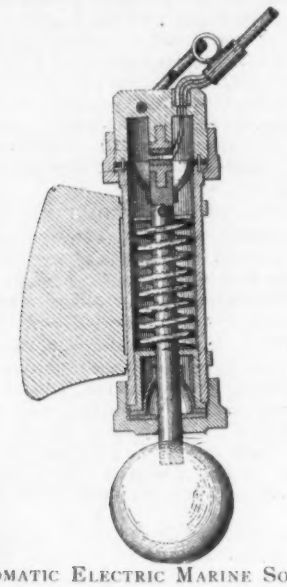
575,054. ELECTRICAL PROPULSION FOR RAILWAY CARS; L. Dion, Natick, Mass. App. filed Feb. 27, 1896. In an electrical railway system the combination of a main electrical conductor having its upper surface grooves longitudinally, and a flexible helically-formed auxiliary electrical conductor adapted to normally rest in the groove of the main conductor.

575,059. BICYCLE ELECTRIC BELL; H. B. Ewbank, Jr., Baltimore, Md. App. filed May 18, 1896. The combination of a bicycle handle-bar and post, a supporting device for a bell and electric battery comprising a plate having a pocket, a hook which takes over said handle-bar and a clip which clamps around said post, an electric battery supported in said pocket, an electromagnetic bell supported on said hook, and a make-and-break device in circuit with said battery and bell.

575,065. RAILWAY SIGNALING SYSTEM; N. Henquin, Schenectady, N. Y. App. filed Oct. 8, 1896. In a railway signaling system, the combination with a time and speed-recording apparatus, which is adapted to be operated by an electromagnet, of two wires extending along the track and connected with said magnet, in one of which is placed a battery, said

track being provided at regular intervals with circuit-closing and breaking devices which are adapted to be operated by an engine, said engine being provided with a device which is always in position to operate said circuit-closing and breaking devices, and with another device which is under control of the engineer, by which said devices may be operated.

575,072. ELECTRICALLY OPERATED PIANO ATTACHMENT; E. J. Simpkins, Toledo, O. App filed Dec. 26, 1895. In a piano, in combination, a series of keys, a magnet adjacent to each key, a perforated strip, a conducting bar over which said bar passes, said bar being in circuit with said magnets, a series of conducting fingers, each in circuit with one of said magnets and adapted to press upon said sheet, and contact with said bar through said perforations in said sheet, a resistance coil, a switch mechanism for switching the circuit to said magnets through said coil, said switch mechanism having a part adapted to be moved by said strip whereby said mechanism is operated independently of said fingers.



No. 575,093.—Automatic Electric Marine Sounding Apparatus.

575,080. TROLLEY HEAD FOR ELECTRIC CARS; W. S. Troutwine, Indianapolis, Ind. App. filed May 22, 1896. The combination with a trolley head having openings to receive the axle, one of said openings being threaded and the other being countersunk and the countersunk end having a transverse pin-hole, of an axle having a head at one end with an outside transverse flange and having a screw thread at the other end, said axle being adapted to be applied to the trolley head, a pin applied to prevent the rotary movement of the axle and a metallic body to contact with the wire and removably secured to the head by means of the axle.

575,090. CLEAT; C. F. Adams, Trenton, N. J. App filed May 11, 1896. A cleat having a groove for the reception of a wire, said groove being provided with teats placed at an angle to the direction of the groove and to the wire.

575,093. AUTOMATIC ELECTRIC MARINE SOUNDING APPARATUS; J. F Babcock, Bangor, Me. App. filed March 11, 1896. An automatic electric marine sounding apparatus, consisting of the combination of a cylinder having a water-tight chamber, a movable rod partially within said cylinder, working longitudinally therein, and having an insulated metallic cap upon its head and within said chamber; a stationary insulated metallic cap within said chamber and in line with said cap on said movable rod, a spring within said cylinder acting against the downward movement of said movable rod, a weight attached to the lower end of said movable rod sufficiently heavy to overbalance said spring, an electric battery and two wires properly insulated connecting the poles of said battery with said insulated metallic caps.

575,039. TROLLEY STAND; J. E. Bishop, Indianapolis, Ind. App. filed Aug. 22, 1896 A trolley stand for electric cars comprising a base plate having a vertically disposed pivot-post, and an integral annularly-bored bearing-cup disposed at the lower end of and surrounding said post, bearing balls arranged in said cup, a swivel head longitudinally bored to loosely fit the pivot-post, and provided at its lower end with an integral depending bearing cone turning inside of the circle of the lower set of bearing balls, and at its upper end provided with an annular rounded recess forming a ball-cup, bearing-balls arranged in the ball-cup of the swivel-head, a cap plate adjustably fitted on the upper end of the pivot-post, and provided with a central depending bearing-cone working inside of the circle of the upper set of balls, wear-bushings facing the ball-cups and bearing-cones, a trolley pole having a yoke pivotally embracing the swivel-head, and oppositely arranged spring-adjusted bars carried by the swivel-head, and having connections with the yoke.

575,116. DIRECT-CURRENT DYNAMO-ELECTRIC MACHINE; M. Hutin and M. LeBlanc, Paris, France. App. filed Feb. 12, 1894. A multipolar continuous-current dynamo-electric machine of the closed-circuit armature type, provided with a commutator having a lesser number of segments than there are armature sections, and means for rotating the said commutator at a proportionally higher speed than the rotor.

575,131. SIGNALING APPLIANCE FOR TELEPHONE SWITCH-BOARDS; C. E. Scribner, Chicago, Ill. App. filed Nov. 4, 1895. The combination with a plug circuit of a telephone switchboard, a calling key in the plug circuit, and a source of signaling current having its terminals connected with the switch-contacts of the calling key, of a ground connection to the middle point of said source of current.

575,144. APPARATUS FOR STOPPING ENGINES; G. W. Brown, West Newbury, Mass. App. filed Oct. 4, 1895. The combination with a vent-controlling valve, of an actuator therefor, an armature serving as a detent normally restraining said actuator, and speed-controlled means actuated by the power of the engine to displace said detent by centrifugal force.

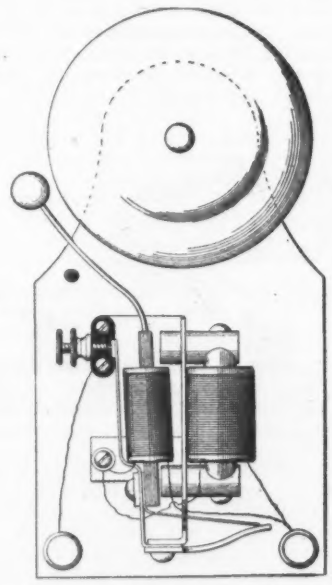
575,156. ELECTRIC BELL, J. W. Holdsworth, St. Louis, Mo. App. filed April 9, 1896. In an electric bell, the combination of a fixed electromagnet comprising a bobbin and a core, and a movable electromagnet comprising a bobbin mounted upon a vibrating core arranged parallel respectively to the fixed bobbin and core and having both the poles of said vibrating core arranged in magnetic relation to the poles of the fixed core of opposite sign; lateral extensions being provided on both the poles of one of the cores and at right angles thereto so as to bridge the space by which the cores are held apart by the bobbins and bring said cores in contact relation, and thus close the magnetic circuit between them.

575,170. ELECTRIC CONDUCTOR; H. T. Richards, Brooklyn, N. Y. App. filed Nov. 20, 1896 An insulated conductor provided with a marker occurring at periodic intervals throughout its length and projecting from the surface by which its identity may be recognized.

575,186. TELEPHONE SYSTEM; J. H. Weckel, Breakabeen, N. Y. App. filed March 7, 1896. The combination with a main line, including in its circuit a plurality of stations each having a transmitting and receiving apparatus and a signal, of a central office normally in the circuit of the main line through the medium of a switchboard, a supplemental signal at the central office connected with the switchboard, and one or more lines normally in circuit with said signal through the medium of the switchboard, said switchboard being adapted to throw the side line into circuit with one section of the main line and at the same time to throw the remainder of the main line into circuit with the supplemental signal.

575,210. DYNAMO-ELECTRIC MACHINE; G. L. Campbell, Kinsman, O. App. filed Oct. 8, 1895. The combination of the armature, field-magnet supports movable toward and away from the armature, field-magnets mounted to move with said supports and pivoted thereto to swing in planes extending longitudinally of the armature, and means for holding the field-magnets in position.

575,231. STATIC GENERATOR; A. J. Gawne, Sandusky, O. App. filed Oct. 10, 1896. In a static-electric generator, the combination with a table, a post secured thereto, a shaft secured to said post, rotatable spools mounted on said shaft provided with flanges at their meeting or inner ends, pulleys mounted on said spools, oppositely rotatable discs clamped between said flanges and pulleys, and screw nuts engaging with the ends of said spools, of a driving pulley located beneath the belt passing therearound and around the said pulleys, the frame secured to the upper end of said post, a vertically movable bar having screw-threaded openings, screws passing therethrough and pulleys journaled to said bar, around which said belt also passes.



No. 575,156.—Electric Bell.

575,235. ELECTRIC CURRENT REGULATOR; W. Hawker, Windsor Mills Canada. App. filed Sept. 25, 1896. An electric current regulator comprising a pair of resistance coils, lead-wires having shunt connections with one end of said coils, a pair of contact-plates with which the lead-wires connect, pairs of contact-plates having shunt-wire connections with the coils at different points of their length, a pair of contact-plates common to all the other pairs of contact-plates and adapted for connection with a lamp or other device, a block carrying contacts for connecting the last-named contact-plates with either single pair of the first-named contact-plates and a screw shaft for moving said block.

575,303. ELECTRIC RAILWAY; G. W. C. Lomb, Birmingham, Ala. App filed Feb. 18, 1895. In an electric railway the combination with an electrical conductor and insulating envelope, enclosing same with contact-making pieces therefor, of a continuous hanger for holding said conductor and its insulating envelope, and a trolley wheel having a portion of conducting material, in contact with said envelope, and provided with flanges of insulating material, embracing said hanger riding upon and guided thereby.